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**SIR SHANTI SWARUP
BHATNAGAR, F. R. S.**



Dr. Sir Shanti Swarup Bhatnagar, Kt., O.B.E., D.Sc., (Lond.),
(Hon. Oxon, Patna, Delhi, Lucknow), F.R.S., F. Inst. P., F.R.I.C.

**Sir SHANTI SWARUP
BHATNAGAR F. R. S.**

A Biographical Study of India's Eminent Scientist

By

NORAH RICHARDS



**NEW BOOK SOCIETY OF INDIA
DEVNAGAR, KAROLBAGH, NEW DELHI**

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Dedicated
To
BUDDING SCIENTISTS
OF INDIA

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Introduction

It gives me great pleasure to say a few words by way of introduction to this book. Of course, my dear friend and one-time research student, Sir Shanti Swarup Bhatnagar, needs no introduction from me. He has by his own merits won for himself a distinguished and important position both in the world of pure science and in that of science as applied to industry. Having by his own researches, as well as those of his pupils and collaborators, built a great school of scientific investigation at the University of the Punjab, at Lahore, he has been called to the high and important post of Director of Scientific and Industrial Research to the Government of India. No better man could have been chosen, for Sir Shanti possesses a rare combination of qualities—great energy and power of concentration, excellent judgement, first rate scientific knowledge and imagination, and high ideals. Moreover, he had already during his career at Lahore rendered valuable services in connection with important technical processes and industries in India. So he is a man who well understands how to apply scientific knowledge and methods in practical industrial life.

Inspired by a sincere and abiding faith in the prosperous future of his country and endeared to all who know him by his friendly and warm-hearted disposition and his entire unselfishness, Shanti Swarup Bhatnagar is destined to go far in the realization of his ideals.

The author of this book has incidentally given us a most interesting account of his family and antecedents. She has drawn a portrait of Sir Shanti the man as well as the scientific leader for which we all owe her a great debt of gratitude. Her book will be read with deep interest by his many friends and admirers throughout the world.

Hartlip,
Kent,
England.

F. G. DONNAN.

Author's Note

This book on Sir *Shanti* would be incomplete without something said in relation to that which paradoxically threatens the peace of the world and at the same time is compact of the promise of peace. Atomic energy will either destroy the world or recreate it; making it safe for Culture—homo—culture. The Age of Man is upon us, of the Son of Man—latest progeny of Mother Earth who is justified of all her children, be they of the North or the South, of the West or of the East. The word *global* has swung into our vocabulary, connoting One-World. Such a World could not manifest until the coming of the Atomic Age. In this age our terrestrial globe becomes *one* on a higher spiral; or, it joins the lost continent of Atlantis by possessing a power that it could not or would not control.

Thinking war will not bring peace, however much we exert our volition in the matter, for will is powerless against the imagination. When the moment comes for decisive action, imagination always wins. Thinking peace will bring peace, however potent our researches for the destructive use of nuclear energy. When the Son of Man—crucified humanity—has risen, Power will be dead; and the findings of nuclear energy

will be able to do no other than create a new earth and thereby, a new heaven.

"In our Atomic Age, Time and Distance are annihilated. What now are the mere 200 years of British rule in India that will end in four days? What the 700 that followed the Muslim invasion?—mere specks on the shores of Time.

The Age of Innocence preceded the Age of Sin and now, an Age of Regeneration is upon us. Soul : Brain ; Mind. These the pivots of each. We give to them a sequence of numerical signs from A.D.1. we count back to infinity and from the same year we count forward—to "Hiroshima." From "Hiroshima" we must begin again. Both B.C. and A.C.—as Jawahar Lal prefers to call A.D.—have vanished. Again we are to count to infinity, but this time—forward. We are in the year of grace Atomic Age 2, not in the years of *disgrace* "A.C." 1946-47. I quote from an Author's Note written for this book dated 11 August, 1947. Later it was amplified by a few lines dated 10 October, 1947, after the terror in India had somewhat spent itself. That Note is out dated and my publisher asks for another. It was impossible in those days of communal carnage to write anything topical that was not tinged with the horror of passing events. Yet even in the note of 11 August, before the worst had happened, it was written "Let the dead past bury its dead. It is life that calls." These sentences now have added emphasis and I repeat the opening lines of the same Note.

"The transfer of power to India has had such a headlong course and decisions have been made at such breakneck speed that this book, and even the postscript, is already out-dated, and it has become, even before going to press, a period book—a book that is pre-partition. Since, however, pre-war writings often flash a searchlight on the post-war world, pre-partition writings may sometimes throw a light on post-partition India. If blood-letting is a vent for sickness India is surely cured of the malady that led to partition.... At the moment, scientists are the ballast of India, a ship still tossing on tempestuous seas."

To mere mass massacre the world has become accustomed-through repetition. It began with what we can now look back upon as almost harmless "air raids" that worked up to the "blitz" and culminated in "Hiroshima."

On the 6th August, 1945, humanity was shocked into awareness. What has rudely awakened Man is the power of nuclear science to destroy not only masses of sentient human beings and obliterate great cities, but to destroy the world itself, to end civilization and throw surviving mankind back to primitive savagery. This power is the result of a direct process—the process of research in nuclear physics. It has been achieved through *conscious brain activity*. What now is needed to curb the destructive power of the Atom is to harness the creative power of *unconscious mind activity*.

The stupendous task before us is to evolve Mind out of Brain. In our One World will be no place for separatism and isolationism. These would die of inanition in the realm of Mind. The good has been the aim of all religions in A.D. but there has been a pitiful missing of the target. The Atomic Age is based upon scientific findings in which is no place for misfires. The target must be hit. To strike good is to annihilate Evil—that which cannot be resisted but *can* be overcome.

The Atomic Age, of which this year is *Annum Tertium*, is a clean cut from the past. Once more we are "In the Beginning" as was fabled in the Garden of Eden. Our tree of Knowledge is the Tree of Power—and its fruit is forbidden.

It has been said that in a regenerate world there will be no priests, for there will be no sin; no physicians, for there will be no disease; no teachers, for there will be no ignorance; but always, there will be engineers. Engineering—planning, manipulating, setting in motion for a specific purpose—includes both Science and Art. These, let us hope, will be twin screws of the Ship of State of India—a ship that has yet to be built and launched.

Science and Art are *one*—a statement difficult to elucidate in words; and yet, a poet once declared.

"Truth is Beauty-Beauty Truth".

Science stands for Truth and Art for Beauty. When these come into their own, hand in hand

in a One World, it may safely be said that Regeneration will be in its stride.

In Science circles, all eyes are turned to the energy that contains within it potentialities of sure death or sure life. It is a matter of choice between Power or Culture. We cannot have it both ways. Power would harness Atomic energy for bombs hastening the Last Day. Culture would harness it for good in life hastening the First Day.

Natural evolution leads to material progress and is the handmade of Power, moving unconsciously, in ordered sequence, from bow and arrow to the Atomic bomb—from death to worse than death. Creative evolution moves consciously, in ordered sequence, from life to fuller life—it is the handmade of Culture. The trend of Power is to destroy for its own ends—for nations. The trend of Culture is to create—for others. There is a Science of death—dealing and a science of life-giving. Budding Scientists of India will surely choose the latter. It will not be plain sailing—the wind will often be against them, calling for careful navigation. The choice will entail the “labour and fortitude” that Dostoevsky in *The Brothers Karamazov* associates with “love in action—a harsh and dreadful thing compared with love in dreams.”

Power loves, in dreams; but
Culture loves, in action.

In this book I have but given a glimpse into some fifty years of the life of an Indian Scientist. It is the account of a layman for laymen, among whom as yet are the budding Scientists that I am confident will be inspired by the unusual subject of this biographical sketch—Shanti Swarup Bhatnagar, whose 'Baptismal' name of Shanti has provided a staff from which to fly the flag of Peace.

Woodlands,
24 April 1948.

NORAH RICHARDS.

“ Greed, self-aggrandizement, self-preservation and preparation for war are still believed to be the surest guarantees for peace.....”

24th February, 1939. *S. S. Bhatnagar.*

“ India requires a supreme science commander, with two committees to advise him and several joint boards under him, to plan and apply scientific research to India's development.”

8th February, 1944. *A. V. Hill.*

“ I believe that all problems, both world problems and national, should have a scientific approach. That is, that the approach should be imbued with the spirit of science and proceed by the scientific method. That method is co-ordinated planning.”

3rd January, 1947. *Jawaharlal Nehru.*

CHAPTER I

Shanti

Shanti Swarupa signifies the very form of peace.¹ This name was given, in infancy, to the elder son of Shrimati Parbati by his father, Parmeshri Sahai, because it seemed to him that, by the movements of the babe, he would be just the reverse. The unconscious thought of the father may have been that the mere sound of *Shanti* might have a steadying effect upon his offspring. Later in life, this mercurial atom wrote under the pen-name of *Simab*² the meaning of which is *mercury*.

Shanti Swarup Bhatnagar was born on the 21st of February in 1894 at Bhera in the district of Shahpur, Punjab. His mother was the elder daughter of Munshi Pearey Lal, of Sikanderabad, in the United Provinces; and his father was the eldest son of Munshi Manohar Lal, of Panipat in the Karnal district. Both father and mother belonged to the *kayastha*³ community. On his mother's side, Shanti Swarup inherited scientific and poetic tendencies; while from his father he inherited a spirit of independence.

1. *Shanti*—Peace. *Swa*—self. *Rupa*—form (The final a not sounded).

2. pronounced *Seemab* (long a).

3. *Kayastha*, pronounced *Kayast*—a writer caste.

Parmeshri and Parbati were nominally married in childhood, at eight and seven years. The real marriage took place nine years later. During the first marriage days Parmeshri wept—mere childish tears for some trifling cause. This was at Sikanderabad in his father-in-law's house. When the marriage party, in continuation of the ceremonies, was at Panipat, Parbati wept.

"Why are you weeping?" they asked.

"He wept at my father's house, and why should I not weep at his?"

"But now he is happy, flying a kite."

"Then let me fly a kite too," was the prompt reply.

The tears of the little bride and bridegroom may have been caused by the shadow of coming events, for Parmeshri Sahai died on October 26th 1894 at the age of twenty-two, leaving Parbati at twenty-one with a daughter of two years and an infant son of eight months. This infant was Shanti Swarup.

Shanti's father, Parmeshri Sahai, appears to have excelled in English and History, but according to his friend Rai Saheb Raghunath Sahai, he "cut a sorry figure in Mathematics." A close and deep friendship existed between these two. They had been playmates in childhood at Panipat, their homes facing each other. Both of them were members of orthodox Hindu families, and both of them had chafed under the restrictions that hemmed them in on every side. Many a time they exchanged identical experiences against which, as boys, they unconsciously rebelled. It is remarkable how these two succeeded in finding

their way out of the maze of superstition and dead custom that surrounded them. Escape they did from the maze but not without much friction in their homes, where they were severely admonished and thoroughly disapproved of. The frustrations with which they were beset led to passionate resistance and, even as schoolboys, they had many serious talks on what seemed to them the foolishness and futility of so many of the taboos to which they were subject. As they grew out of boyhood their thoughts speedily matured and by the time they were ready to go to college they had become fired with the zeal of reformers.

Even in those days there was a fair sprinkling among college students in Lahore who, if not actual social rebels, were uneasy in their minds and always ready to discuss social problems. The position of women engrossed them, also the need for better education and more of it. Some of them became severe critics of religious superstitions and began to tilt against them.

Parmeshri Sahai had joined the Forman Christian College and Raghunath Sahai the Government College. The atmosphere of these institutions differing widely, the friends had much to say to one another of the reactions they were each making to their new environments.

Parmeshri lived with his wife in the house of his uncle Munshi Nand Lal of Panipat, senior reader in the Chief Court at Lahore; while Raghunath Sahai lived in a Government College hostel where the atmosphere was more conducive to free discussion, so in their leisure hours they

mostly met there. Moreover Parmeshri's wife, Parbati, was made to keep *pardah*¹ from her husband's friend, causing a social obstacle and resentment. College students attracted by the vivacious and eager talk of Raghunath and Parmeshri used to drop in and join them in their questionings of life, until quite a respectable group of young men from various colleges materialized. They haunted the rooms of Raghunath Sahai who, being a *Kayastha*, formed a *Kayastha* Literary Society. It is more than probable that the subjects they discussed were social rather than literary and that membership was not limited to *Kayasthas*.

It was at this time that new objectives swung into view for Raghunath and Parmeshri. So far, they had been concerned with social matters to the exclusion of all else, but the coming to Lahore of Brahmo Samaj leaders opened out vistas of religious free-thought. The free-thinking of the Brahmos was not mere negative reaction. It is true they destroyed old values in religious outlook but also they created new ones. Their's was an influence for which the friends were ripe. The principles of Brahmoism found ready response in the minds of Raghunath and Parmeshri, their own resistance to frustrating religious orthodoxy having paved the way. Their adherence to Brahmoism was profoundly to affect their lives. It led them to meticulous care in the choosing of a profession. They both decided to follow the profession of teaching rather than those that were

1. *Pardah*—Curtain, meaning cloistered.

judicial or administrative. To Raghunath Sahai it gave a lead that he steadily followed throughout his long life.

At the end of their first year together at Lahore the friends were destined to part. Raghunath joined the Stephens College in Delhi whither his family had gone to live, while Parmeshri eventually went to Bhera as Second Master at the Anglo-Sanskrit High School. His father had died, which necessitated his leaving the Forman College and studying privately. He took up tuition in the Dayanand Anglo-Vedic College to make himself independent of his uncles. At Bhera he continued to study privately. From there in 1893 he went to Lahore to serve as a volunteer at the Indian National Congress. In March 1894 he sat for his B.A. Examination, which he passed with distinction in History and English.

Meanwhile Raghunath Sahai, after taking his degree, was appointed Headmaster of the Batala Mission School. Here he began his career as a notable educationist. He greatly missed the constant companionship of Parmeshri Sahai. They did not prove to be good correspondents, each being pre-occupied with his chosen profession of teaching. Between them was the bond of true friendship that could not be severed, even by neglectful silence.

One day a letter came giving news of Parmeshri's sudden illness. Raghunath's conscience then smote him for his long silence. He did not, however, take the news very seriously. Knowing that his friend had a strong constitution he

apprehended no danger. He sat down to write a letter to hearten the sick man, telling him of the many happenings and thoughts he wanted to share with him, and of the new life that was opening out for them both. Before the letter was finished a telegram was delivered to him telling of Parmeshri's death.

Stunned by the blow and shaken with grief he left at once for Bhera. His arrival coincided with that of Parbati's father, Munshi Pearey Lal. They found consternation : all had been so sudden that thought was frozen. Parbati, the bereaved, with the infant Shanti in her lap, was sitting as one turned to stone, while the baby girl at her feet innocently prattled.

The appearance of Munshi Pearey Lal and L. Raghunath Sahai had a calming and a steadying effect on the stricken household. Already the funeral arrangements were well under way, directed by Malik Hans Raj, a neighbour who had been with Parmeshri Sahai from the moment of his seizure, two days before. Panna Lal, a cousin, had been summoned from Lahore the day before and was the only relative who had been present at the death-bed. Parmeshri had been popular in Bhera and had many good friends. His funeral was attended by people of all classes.

Since Parmeshri Sahai's father and mother had both died and his uncles were in Lahore, there was no question of Parbati living in her husband's home. Moreover, there had been disagreement about his advanced views in social matters. So Munshi Pearey Lal took his widowed

daughter and her children back with him to Sikanderabad.

Hindu widowhood carries its own burden and the unhappy Parbati bore hers with courage in her old home where she had once been an honoured and cared-for daughter. Being a woman of strong and noble character she accepted her lot uncomplainingly. She was, after all, a widow in an orthodox Hindu household and nothing could alter that fact and the inescapable position in the home that it entailed. A Hindu widow is looked upon as ill-starred, unwanted, except as a household drudge. Parbati's father, in spite of his orthodoxy, never made her feel her position, but his household reaped the benefit of her untiring service. She became indispensable to the family and so her lot, such as it was, was secure. She and her children were never in need of the necessities and the creature comforts of life. Here, in her parents' home she found sanctuary with her little daughter of two years and her infant son, Shanti. Five months after the death of her husband a posthumous son was born.

At this time the members of the household of Munshi Pearey Lal were his wife, and their two sons Jawala Dyal and Devi Dyal. Parbati's younger sister was married and lived in her husband's home. Her younger brother, Devi Dyal, was but two years old, the same age as her own little daughter, so she and her mother had much the same interests and duties. Later, when she was able to do so, she relieved her mother of much care and responsibility in the home. She was a very capable housekeeper and her cooking

was greatly appreciated, especially by her brothers who refused to eat from any hand but hers. These were uneventful days for Parbati watching her little family grow and grow.

Gradually the health of her mother deteriorated, until she became an invalid and eventually bed-ridden. As her illness grew upon her she found relief in smoking a *huqqa* which she did off and on all day and so the fire in the *chillum*¹ had constantly to be rekindled. This task little Shanti, as he grew out of babyhood, took it upon himself to perform. He and his grandmother became fast friends. He used to fetch and carry for her in many ways. In fact he was more attentive to her than her own sons. She used to call him her little *sepahi*—her little orderly.

When eventually Parbati's daughter was married, at the age of seven, she was a little troubled about money. She sold some jewellery and added to it the golden *mohurs* she had received at her own marriage in dowry, and that she had saved intact.

The first marriage, and that of a daughter, it was celebrated in the Panipat home of her departed husband. When the *Kanya Dan*³ ceremony was over she wept recalling her sorrowful loss. There is a legend that that night she dreamt her husband came to her and showed her a certain place in the house where money had been hidden. The next day she recounted her dream and point-

1. *Huqqa*—'hubble-bubble' pipe.

2. *Chillum*—Small earthenware receptacle to hold the live coal.

3. *Kanya Dan*—giving away the bride.

ed out the spot that had been shown to her. They dug and sure enough there were sovereigns buried there. They were presented to the little bride as a gift from her father.

It was at Sikanderabad, under the guardianship of his maternal grandfather, that the childhood of Shanti Swarup was passed. His grandfather was an engineer, one of the first to have qualified at the Roorkee College of Engineering. At the time he received his widowed daughter and her children, he had retired with ample means.

The home of Shanti's grandparents was in an old building that had been occupied by three generations preceding that of Munshi Pearey Lal. It was entered by a gated archway from a narrow lane in the city. To the right was a two-storeyed dwelling occupied by Munshi Pearey Lal. Below the main room on the ground floor was a *teh khana*¹ and on the flat roof above the upper rooms a *barsati*². A quadrangle fronted the house and opened on to another that was surrounded by the dwellings of Munshi Pearey Lal's elder brothers, Tanna Lal and Munna Lal. The former, eldest of the three, was a spendthrift and had got seriously into debt from which he was extricated by his youngest brother who paid down a large sum of money to clear him. Incidentally, Pearey Lal became involved in law suits on his spend-thrift brother's account that lasted on and off for a period of fourteen years. Tanna

1. *Teh Khana*—an underground room, built for coolth.

2. *Barsati*—a rain shelter.

Lal had forfeited all rights in the family property, his share having gone to Pearey Lal.

An ancestor of Shanti Swarup was Munshi Har Gopal who became a renowned poet, writing under the pen name of "Tafta."¹ Har Gopal had been a *Kanungo*² but after struggling with his duties he resigned, for he could take no interest in them. A serious-minded man of fastidious taste, he loved simple ways. He had made a collection of rare books and manuscripts which he housed in the *teh khana* of Pearey Lal's part of the old home.

Tafta and the great poet Ghalib, in spite of their widely differing age, had been fast friends; indeed they appear to have been affinities. Ghalib lived in Delhi and they frequently stayed with one another. It made no difference whatever to Tafta that Ghalib was a Muslim. He ate and drank with him as though he had been a Hindu. The prefix of *Mirza* that had been bestowed upon him by Ghalib was a Muslim designation, meaning offspring of a leader, and by it he was always known. His clothes were Muslim in character and his Turban folded in a Muslim way. *Mirza Tafta* wrote his poems in Persian. In fact he was as much Muslim as Hindu. The dividing line between the two communities had, for him, been obliterated. In the art of verse-making he learnt much from Ghalib, and even when he had made his name as

1. pronounced. — *Tufta*

2. *Kanungo*—a rural official who scrutinizes the revenue records of the *Patwari*.

a poet, he still took his latest poems to him for approval.

"Why do you seek my help?" asked Ghalib, "You have now become a true poet."

"Because you have always been and always will be my Master, and because I have always been and always will be ready to learn from you."

Once when Tafta had been told that Ghalib was angry with him, he wrote in great distress. To his knowledge he had given no slightest cause for offence, but if he had unwittingly done so he implored forgiveness and to be reinstated in his favour. To this Ghalib replied "Efface for ever the false rumour from your memory. You are the only man in India with whom I could never be angry."

The friendship of these poets was filled with romance, and when Ghalib died, Tafta was heart-broken, as can be seen from the following lines.

Ghalib was he who, by loving patronage,
Made known thousands of humble men like me.
Excellence—Integrity—Beauty—Love
Words his death has severed from head and feet.

Ten years later Tafta died in the *teh khana* of his ancestral home at Sikanderabad, surrounded by his loved books. When he felt his end approaching, he asked to be carried there. Tafta's books were bequeathed to Shanti Swarup by his grandfather and in 1919 he presented them to the University Library, Lahore, where, in the Persian wing, they were known as the Tafta Collection. In the reorganization of the library the books were scattered, so as the Tafta Collection they

are not to be found. Among them was a Persian version of the Mahabharata for which Shanti Swarup received a small sum of money from the library authorities.

Under the influence of his grandfather Shanti developed an interest in engineering and also in Physics and Chemistry. Clay-modelling greatly attracted him and he spent much time at it. In this his grandfather encouraged him but he was often reprimanded by others as wasting his time. He took much interest in his grandfather's geometrical instruments. At the age of eight he used to make mechanical toys. He had constructed a steam engine and one day, to his great joy, the clay vessel that served as a boiler, burst. He well remembers the keen pleasure he derived from the explosion that caused the engine to move forward, just a little, on the crude rails.

His grandfather, tall and lean, was a venerable figure. He usually wore a white *churi dar pajama*,¹ a tight fitting long coat buttoned up to the neck, with a wide flare below from the waist. Over this he wore a *choga* a loose embroidered cloak. He was bearded and his hair was white. He wore a cap and carried a long silver-mounted stick. In appearance, he belonged to the Moghal past. His ancestors had held high office in the Moghul Court as had also the ancestors of Shanti Swarup's paternal grandfather, Munshi Manohar Lal. The title of Khwaja-i-Khwajgan

1. *Churi dar pajama*—tight trousers rucked at the ankle.

had been conferred upon this side of the family in Moghul times.

Shanti had not much contact with his paternal relatives, since his father had outraged their orthodox Hindu sentiments by becoming a Brahmo. Also, Parmeshri Sahai had taken an independent line of his own in choosing an unworldly cultural profession rather than a profession in which he might have risen to great heights of prestige and power. This independent spirit that the father of Shanti had shown led to his having been ostracised by his nearest relatives. When, therefore, Parmeshri Sahai died, his widow, with two children and the promise of a third, was left entirely without means.

Shanti's grandfather appears to have been something of a disciplinarian, but was never harsh. He did not allow the children any pocket money because he thought it would make them self-indulgent but they were never refused money for anything they really needed. He forbade Shanti and his brother to mix with boys away from the house and had told them never to get mixed up in disputes. When, therefore, they one day saw a boy of their acquaintance in dispute with two or three other boys—a dispute that led to blows—they merely looked on, though they were longing to join the fray. The father of the boy who had been set upon complained to Swami Bahal Rai, the *guru*¹ of their grandfather who took his grandsons to task for their lack of chivalry. The feud continued and the next time

1. *Guru*—Spiritual Teacher.

they saw their boy acquaintance set upon Shanti and his brother pounced upon his assailants and 'gave them hell.'

Munshi Pearey Lal became very religious and retired more and more within himself. He built a new house about fifty yards distant from the old one. The motive for this new building was to accommodate the wedding guests at his elder son's marriage. The first marriage of a son, it was to be celebrated with great *eclat*. When the wedding was over, the grandmother with her sons Jwala Dyal and Devi Dyal, and Parbati with her daughter and younger son took up their abode in it, but the grandfather returned to the old home and became more and more of a recluse. Shanti remained with him. All food was served in the new house, so that the whole family met at meal-times. They came together frequently, in the evenings, for poetical contests and on occasion, for a *mushaira*.¹ This close contact with his grandfather had its unmistakable effect upon Shanti. It also gave him an experience of solitude. When asked if he liked company in his childhood, he hesitated, "I did not *have* company" he answered, which shows that he did not *seek* company and that most probably he actually liked solitude. That he could bear it, was evident. As time passed, the ageing grandfather became more and more disinclined to emerge from his retreat.

The old home, having no garden, land had been brought by Shanti's great grandfather at a

1. *Mushaira*—A poets' symposium.

distance of half a mile, where fruit trees were planted—mainly mangoes and guavas. As the years passed, more land was added to the garden and when Shanti appeared on the scene it was quite large.

The grandchildren were forbidden to pick the fruit, but young Shanti, nothing daunted, used to climb the trees and have a good feast. Fruit-stealing in childhood is no crime. It is an escapade of which few grown-ups are innocent and those few must have been most unnatural children. Shanti was good at tree-climbing and seldom missed a chance of losing himself in high branches, even if those branches bore no fruit. Once at Jhajjhar, he had climbed a dangerous old *neem* tree and, on descending, one of his uncles had given him a sound beating. When, on occasion, his grandfather had found him feasting up a mango tree, Shanti had been reprimanded, but never beaten. In fact the escapade had usually ended in a joke at the culprit's expense.

It was their custom, at the height of the mango season, to have hundreds of the luscious fruit plucked and thrown overnight into a well-filled tank in the garden. In the cool of the day the family would assemble and collect mangoes from the water, sitting around to enjoy them fresh and cool. Young Shanti, with his well-known predilection for mangoes used to be thrown into the tank and told to eat his fill. He is pretty sure to have done so, but it is more than likely that these cooled mangoes did not taste quite so sweet as the warm ones he climbed for—spiced with secrecy, danger and mischief

The pleasures of the garden were enjoyed by many and among them was Tafta's friend, Ghalib, some of whose many verses on the mango were undoubtedly inspired by happy hours spent there. He was wont to say that the essential attributes of a mango were "sweetness and many." One Mango, however sweet, was for Ghalib no mango.

Come, pen, describe the incomparable mango,
Be as a tree that scatters its heavenly fruit.
Beside it not one can raise its drooping head,
Sweet grape is but a bitter bursting blister.
May-be, over flowing with loving-kindness,
The maker of all celestial nectars,
Bade gardeners of heaven to drop it, gently—
A green globe filled with golden honey,
Well closed with God's own seal.

This translation does scant justice to the terse and melodious lines of Ghalib, but they indicate the delights he had found in the mango grove of the family garden at Sikanderabad in the company of his beloved Tafta.

These were happy care-free days for Shanti Swarup, living under his grandfather's wing, sharing the peace of his retreat in the old home and the joys of the garden. The day came, however, when he had to curb this freedom and go to school. On the first day he was accompanied by his grandfather.

"Who is your father?" he was asked.

"This is my father," he replied, looking up at the only father he had known.

"No, Shanti, I am not your father. I am your grandfather."

"Then where is my father?"

“Your father died when you were a baby and since then I have taken your mother and you children into my care. I am only your grandfather.”

At these words, Shanti wept. He wept all day and his mother wept. The flood gate of tears had been opened. The child of six had now become a boy, whose school days had begun clouded with the sorrow of bereavement.

Shanti Swarup.

In his school days Shanti Swarup was a mixture of studiousness, industry and impishness. His first school was a *Maktab*¹ in Sikanderabad and the second was the Anglo-Vernacular in the same town.

He was a terror to his teachers and to this day is quite good at leg-pulling. He used to tease them by asking uncomfortable questions. A precocious lad, he was in some subjects in advance of his instructors, notably in Urdu poetry. He did not hesitate to point out flaws in their exposition, but this he did in a jocular manner that yet was bold. Recognizing his precosity and disarmed by his manner they were not offended but in self protection did their best to avoid occasions of discomfiture.

On one occasion, however, he did give offence but this was by reason of witty impudence, rather than precosity. A riot had

1. *Maktab*—a Persian word derived from *kitab*—a book—signifies a primary school, the medium of teaching being Urdu.

broken out in a village nearby and Shanti's uncle had gone to investigate. One Moti Ram, a teacher in the Anglo-Vernacular School, asked the boy what had been the result of his uncle's investigation—what had happened? "Oh, nothing very much," was the laconic reply "Just a *Moti Ram baje*."¹

This punn on his name and its implication infuriated the self-important Moti Ram who was a strong fellow and something of a bully. Shanti, the impudent, was tied up by a *pankah* rope and beaten by the victim of his wit.

At the same school his drawing master resented him because he outstripped in intelligence a favourite of his. Shanti used to get unmercifully squashed and snubbed at his drawing lessons. As may well be imagined he did not take this lying down and the result was clash and constant friction. He was so unhappy under these conditions that he asked the Head Master if he might be excused from attending the drawing class. The subject, not being compulsory in those days, he was let off. The boy was fond of drawing and so had steeled himself against the persecution of the drawing master and endured it as long as he could. By giving up his drawing lessons he felt frustrated.

In 1908 Shanti left Sikanderabad for Lahore to join the Dyal Singh High School of which Lala Raghunath Sahai, was then Headmaster. This old friend of his father's had prevailed upon

1. *Moti Ram baje*.—Moti Ram is a common name and here *baje* can be translated as ding-dong the sentence signifying much ado about nothing.

Shanti's mother to allow him to go to Lahore for the remainder of his school days. It was very natural that his mother should sadly miss his companionship and his grandmother her little *sepahi*. As for Shanti, his regrets at leaving these loved ones and the home of his childhood, were tempered by his eagerness to meet the new life that was beckoning :

As is so well said in French :

*Les chagrins du depart sont pour ceux qui restent*¹

So it was with Shanti's mother and his grandparents, but by none was he so sadly missed as by his devoted mother. Very soon, however, they were cheered by good news from Lahore, for soon after his arrival Shanti, now aged thirteen, had won in open competition a High School Government scholarship and from that time he helped to pay for his education by private coaching and by the winning of further scholarships. A new interest had now entered into his mother's life and that was the life of her son in Lahore, as conveyed by his letters.

At this period Shanti found in Lala Raghunath Sahai his great inspiration. Also, he had come into touch with two leading Brahmos, Pt. Shiv Nath Shastry and Babu Abinash Chander Mazumdar. In contact with these his free-thinking tendencies were drawn out. Then there was oblique influence upon him of the great Dyal Singh Majithia, by whose bounty the Dyal Singh High School was in existence. The very atmosphere

1. The sorrows of departure are for those who remain.

of the school breathed free-thought. With this background to his studies and new experiences his outlook broadened while his feeling deepened and his thought quickened. The Brahmo Samaj founded in 1830 by Raja Ram Mohan Roy is to orthodox Hinduism what Unitarianism is to orthodox Christianity.

Shanti was well-grounded in Sanskrit, which he began in the 9th class. He did exceptionally well in this subject in his Matriculation examination, and subsequently in his Intermediate.

As might be expected, social service was inculcated into the minds of the Dyal Singh School boys. Shanti entered heartily into such service and was equal to any emergency. One night, when a neighbouring Cinema House caught fire, he roused all the boarders who rushed after him to the burning building. They opened all the taps on the way, collecting buckets and anything that would hold water. Arrived on the scene, Shanti kept half the boys running for water while he and the others fought the flames. They had definitely done something to subdue the fire by the time the firemen arrived. The proprietor was not over grateful. He was even a little supercilious as he looked upon the team and their leader, radiant but rather scorched.

"Foolish boys!" he ejaculated, "I shall get much more out of this fire than I shall lose by it."

The young fire fighters were mystified. When the Headmaster praised them for their courage and resourcefulness, they asked what was the meaning of the proprietor's remark. He enlighten-

ed them on the workings of insurance and, incidentally, they got an inkling of its intricacies.

Moulvi Talib Ali Paband was Shanti Swarup's first science teacher—the medium, vernacular. In the ninth class he took Science in English. He very soon developed an absorbing interest in the subject, delighting in scientific experiment. No sooner had he mastered the elements and principles of electricity than he busied himself making batteries that resulted in miniature telephones and in call-bells. In these days he had contrived for himself a crude laboratory in one of the galleries of the School Hall and had stocked it with old tubes, broken flasks, batteries and any useful thing that by hook or by crook could be got hold of.

Shanti was indifferent about his text books. He was intelligent but not studious, a trait inherited from his father, who was 'wonderfully intelligent, but hated Mathematics.' Like his father, he was also indifferent to clothes. Lala Raghunath Sahai received many complaints from his teachers reporting that he was a great trouble to them, perpetually plying them with questions; that he was restless in the class room and always too ready to retort when admonished.

Towards the end of his school days, a press letter from him was accepted by *The Leader*, Allahabad, on how to make a substitute for carbon electrodes in a battery, by using molasses and carbonaceous matter under pressure and heat. It is significant that in 1942, thirty-one years later, he and his associates developed in their laboratories a process for making carbon electrodes in

which indigenous materials were used owing to the shortage of imported materials due to the war.

In 1911 Shanti Swarup matriculated in the first division. In the same year he joined the Dyal Singh College, with a University Scholarship.

Shanti Swarup Bhatnagar.

The Dyal Singh College, Lahore, as well as the Dyal Singh High School, owed its existence to the good will and the bounty of Sirdar Dyal Singh Majithia. The College, which opened in 1910, was to be non-denominational, in keeping with the principles of Brahmoism. To these educational institutions the great Sirdar, ardent Brahmo and free-thinker, added a public library and a daily newspaper—cultural mediums for the liberation of his fellow-countrymen from the cramping fixed thought that had led to the perpetuation of anti-social customs and orthodoxies. The means by which he hoped to bring about a changed mentality were well chosen—School, College, Literature and Press.

It was the good fortune of the College to have as its first Principal, N. G. Welinkar, a noted Brahmo educationist. He served for two years only but gave the institution a splendid start.

No sooner had the autumn University session begun in 1911 than Shanti, short of stature, was chosen to impersonate Puck in *A Midsummer Night's Dream*. (At this point the writer asks

the indulgence of her readers for an unavoidable literary lapse by writing from the personal angle). The play was produced by myself as a pastoral. My husband, Philip Ernest Richards, had that year been appointed Professor of English Literature at the Dyal Singh College, recruited from the Unitarian Ministry in England as the Chair was to include free-thinking religious discourse. We landed at Bombay late in September and had been in Lahore barely a week when a deputation of students presented themselves, asking would I rehearse them in *A Midsummer Night's Dream*, a play that they were studying in their academic course. I eagerly consented. In Shanti Swarup I found a ready-made Puck. His agility and impishness fitted the part like a glove.

"I'll put a girdle round the earth in forty minutes."

This line stands out most vividly in my memory of his playing of the part. To this day I hear the confident tones of his voice and I see the quick movements that accompanied the line.

An incident at rehearsals was characteristic of him. As I approached the place of rehearsal one afternoon, under two spreading trees in the college grounds, a hot dispute was taking place between him and the student who was playing Lysander. Shanti was furious. Within earshot I asked what the matter was. Shanti darted towards me.

"This man wants me to play Puck like it was played by Professor Jones in Government College. Do you want me to?"

"No, of course not. Play it in your own way." He flew back to Lysander, tall fourth year student, and looked up at him like a cheeky cock-sparrow.

"There—what did I tell you. If *she* does not want me to, why should *you*?"

Not content with drawing the line at Shakespeare, we ventured on modern drama. At the break-up for the summer vacation we put on Lady Gregory's "Spreading the News" which I hoped would stimulate play-writing for a dramatic movement in line with that of the Abbey Theatre, Dublin. Shanti Swarup was cast for the part of the deaf apple woman—Mrs. Tarpey, and played the part well. When the college reassembled after the long summer vacation in 1912, we staged "*As You Like It*" and Shanti played the Melancholy Jaques. After the excitement of our performance had died down a dramatic class was started to stimulate original playwriting. In our college magazine, *The Union*, a competition for a one-act play was advertised in which the prize was to be a paltry fifteen rupees; in those days the equivalent of a sovereign. Shanti Swarup was the first prize-winner. His play, entitled *Karamat* was characteristic of the Bhatnagar of future. It satirized the superstitious healing of a *Bhagat* who was also a rogue, and showed the superiority of the healing that was scientific. This play won the distinction of being banned by the censor, in the person of the then Principal, successor to Mr. Welinkar, who feared it would give offence to Hindu sentiment. Had the founder of the College been the Principal, at the

time, that play would have been performed. It was in line with cultural liberation from cramping orthodoxies and superstitions, and who knows but another cultural medium would have been endowed—the drama.

I had determined that every year the break-up dramatic performance should either be a modern play, as a stimulus to play-writing, or that the programme should consist of original items. Greatly disappointed at not being allowed to play *Karamat*, we set about to write a college satire in collaboration—Kitchen X, Y, Z, by A, B and C. The main collaborators were a science professor N. N. Godbole, my husband and myself. Shanti Swarup composed the incidental songs. Fun was poked all round—professors came in for it, clerks, students and hostel servants. The Principal himself did not escape. Shanti Swarup played a satirized version of himself under the name of Banti Sharup. In character, he recited a ridiculous and rather long poem in praise of the college magazine of which the closing stanza ran thus :

Pride in *The Union* I am always ready to vindicate
But a trifling improvement I'd just like to indicate
Let the size be increased to twice what you see
And fill the extra pages with a monthly poem by

This last line was a dig at the Principal's "Monthly Letter." *The Union* in those days was a leaflet of four pages.

At the break-up of the College year we performed *Kitchen, X, Y, Z* with an original prologue and a revival of "Spreading the News." Our satire was a rollicking success, which the

actors themselves enjoyed hugely, rather over-acting their parts. In fact it got out of hand, with all sorts of innovations and improvizations. At the end of the show that had wound up with *Kitchen*, X, Y, Z an irate student rose to his feet to protest saying the students had been insulted. Professor Richards, who was on duty in the auditorium quietened the angry protestor.

"Leave it to me," he said "I also have been insulted!" Swiftly, he leapt onto the stage.

"Gentlemen, I have been insulted!" Roars of laughter; for this was one of the points of the satire, in fact the pivot upon which it revolved. "Sir, I have been insulted," was a very common complaint to the Superintendent of the hostels. In the satire the hostel Superintendent was a professor named Richbole, composed of both Professors Richards and Godbole, in which the former's bad urdu was made fun of and the latter's enthusiasm for indigenous products was brought in, his pockets being full of samples; so that when he was searching in his pockets for his pocket book, sample after sample came out, each one causing ripples of laughter. The protesting speech was pure satire and a fitting epilogue, greeted by the students with constant laughter and at the finish there was thunderous applause. The satire had made its mark.

This was the last occasion of Shanti Swarup's participation in dramatic activity in the Dyal Singh College, for in September of the same year he left for the Forman Christian College, where he did not allow any distractions from his studies in Science.

Although he did not take active part in our plays after he left the Dyal Singh College, he kept in touch with us and was always ready to give the benefit of his talents. In translation, for instance, "Come away Death" the song in *Twelfth Night* was translated by Shanti into Urdu, in which language it was sung to Indian music by Viola, instead of by Feste, the jester. The part of Viola was exquisitely played by Murli Dhar Mehta, a senior student who was a very good singer. This was an innovation forced upon me as I could not get Indian students to sing English tunes. I had tried and dismally failed, in *As you Like it*, in which I had eventually to cut all the songs, even, "What shall he have that killed the dear?" which was a very simple tune. I had tried hard to get it sung in unison. There is an unwritten dramatic law :

Be absolutely right, but if you cannot possibly be,
Be absolutely wrong—*provided you get the dramatic effect.*

The dramatic effect in this case was absolute. There would have been no dramatic effect at all had it been possible to be absolutely right by having the song sung by an English singer to English music. As it was, even I did not feel any incongruity, and as for the audience of Indian students—they were spell-bound. The fact that the love-sick Viola sang it instead of Feste to the love-sick Duke, added to it poignancy. The translation was excellent. Shanti Swarup has an unmistakable strain of poetry¹ and by some

1. A book of his collected poems entitled "Lajwanti" was published in 1946.

it is said that his poetic style resembles somewhat, that of his gifted antecedent Mirza Tafta.

At the Dyal Singh College, Shanti Swarup had won a college scholarship. His subjects were English, Sanskrit, Physics, Chemistry and Mathematics. Needless to say, he and Professor N. N. Godbole were good friends. By his enthusiasm for indigenous industrial products, Professor Godbole greatly stimulated him. In fact, the stimulation was mutual. At this time he wrote a paper on "*Fermentation Phenomena of Pomegranate Juice*." It was published as an article in *Raushni*,¹ organ of the *Society for Promoting Scientific Knowledge*.

In 1913 he passed his F. Sc. in the first division.

A far-seeing estimate of Shanti Swarup, was written by Mr. Welinker, the first principal of the Dyal Singh College. It was dated the 17th January, 1915, at which time he was Director of Public Instruction at Hyderabad.

"Mr. Shanti Swarup was one of the ablest students in that large class of about 100 students. Indeed, I am of the opinion that in all round ability he was the ablest. He distinguished himself in every branch of the work of his classes—literary, scientific, dramatic, social and he gave the most complete satisfaction to the professors by the excellence of his behaviour. He is a young man of more than usual ability and I feel sure that if he is given opportunities to develop his talents, in some great European or American

1. *Raushni*—Light.

Centre of scientific research, he will do remarkable work in Science and will thus be in a position to render high service to his country."

Shanti Swarup Bhatnagar, Science Student.

The Forman Christian College, as it was at the time that Shanti Swarup joined it, was situated in a rather crowded and busy part. Originally, in 1886, this was said to be "one of the choicest sites in Lahore, centrally situated, covering an area of 5 acres. It was founded by American missionary enterprise which had started pioneer work in 1833, in different parts of India.

The College was named after the Rev. C W. Forman, D. D., who had been appointed Principal, when it had been removed from within the old walled city of Lahore. This was four years after the founding of the Punjab University. Dr. Forman was Professor of Mental and Moral Philosophy. This unusual subject and its implications of training in thought and motive, was largely responsible for the pull it had over its rival and secular institution, the Government College. Dr. Forman resigned in 1888 and Dr. J. C. R. Ewing was appointed as his successor.

The Rev. James Carruthers Rhea Ewing was "the most outstanding personality in the history of the college." These words were spoken by Dr. John Weir in 1927. "With no fuss or pretension or promises, he quietly poured the tidal power of sound judgment, of living interest in the institution and straightway forged forward the movement that never slackened or receded."

Dr. Ewing became Vice Chancellor of the University in 1910 and remained so until his retirement in 1917, having been re-appointed three times. To be Vice Chancellor was a unique distinction for a College Principal¹. In 1923 the K. C. I. E. was conferred on him. Sir James Ewing died in America, at Princeton, on August, the 20th, 1925, aged 71.

Shanti Swarup found the new atmosphere of the Forman Christian College stimulating. Not only was it pervaded by the missionary spirit in mental and moral philosophy—though no professor on the staff now actually professed this philosophy—but also it was pervaded by the missionary spirit in Science, which found in Prof. J. M. Benade a fitting vehicle, and later in Prof. P. Carter Speers. These two scientists greatly influenced Bhatnagar, with both of whom he eventually formed close friendship.

It was at the Forman Christian College that he began his science studies in real earnest. Prof. Benade in Bhatnagar's own words was "excellent in experimental Physics and in the workshop—I did my first piece of systematic research work with him for the M. Sc. in Physical Chemistry on the subject of Surface Tension." This was the starting point of his career. All other interests were now subdued to that of Science and with unflagging energy and undaunted spirit he has gone from strength to strength. It seems strange, in the light of his subsequent achievements in Industrial Chemistry, that in his

1. History is repeating herself. Dr. Rice, Principal of the Forman College has this year (1947) been appointed Vice Chancellor.

college days he did not make it a special subject of study. The Forman College, with Professor Carter Speers as initiator did pioneer work in this branch of study and experiment. Carter Speers was the Father of technical education in the University and of Applied Chemistry. The thorough grasp of theoretical Chemistry, that Bhatnagar acquired in his student days stood him in good stead as an industrial chemist. It was, in fact, as Prof. Speers himself wrote in 1943, *apropos* of S.S. B. "the very first requirement of an industrial chemist."

For his B. Sc., Bhatnagar had taken as his subjects, Physics, Chemistry, English and Honours in Physics. A strange happening befell him. He failed in the B. Sc. He had crashed in Chemistry! Yet not so strange, as the following incident will show.

He was unwise enough—from the examination point of view—to read on his own account books that were not text books. He had read in one of them that it had been shown that X-rays could be reflected, refracted and polarized just as ordinary light, but Mellor's Text Book of Inorganic Chemistry, which was then the examiner's guide, said otherwise. It so happened that one of the questions on the examination paper was about X-rays, their properties and applications in Chemistry. Naturally, Bhatnagar's answer was in accordance with his wider reading in which he was in advance of the professor who failed him. In 1916 he took his B. Sc. with Honours in Physics. He must have been wise enough—from the examination point of view—to

curb his habit of wider reading than that of his text books.

“Of course it is necessary for a student to learn so far as is possible, what has already been done. I would not urge that a young man should not master or at all events study, a great deal of what has already been discovered before he attempts to soar on his own wings. But there is all the difference in the world between the point of view of the student who reads in order to qualify for an examination, or to gain a prize or a scholarship, and the student who reads because he knows that thus he will acquire knowledge which may be used as a basis of new knowledge. It is that spirit in which our Universities in England are so lamentably deficient.—For this condition of things our examinational system is largely to blame.”

Thus spoke Sir William Ramsay, K. C. B., F. R. S., in an oration delivered on *University Education* at University College on July 6th, 1901, afterwards published in a book in 1908, entitled *Essays Biographical and Chemical*, in which the last essay was the oration delivered in 1901, and was entitled *The Functions of a University*.

Before he had taken his B. Sc., Bhatnagar had solved an industrial problem. The leading stationer in Lahore had been unable to procure hectographic pads, for duplicating, as the supply from Germany had ceased owing to the war. The stationer applied to Prof. Carter Speers and asked him to solve the problem. Speers had no time to get down to it and passed it on to Bhatnagar

who solved the problem and received for his labours one hundred and fifty rupees. At this time Bhatnagar had perforce to earn, so the sum he received for his hectograph was very welcome. After taking his B. Sc. degree he accepted a post of Demonstrator in the Physics and Chemistry Department of the Forman College and later he became a senior Demonstrator at the Dyal Singh College. During the whole of his college days he had been in straitened circumstances. As an undergraduate he had earned his examination fees by making an inventory of the contents of the Forman Chemical Laboratories.

In 1917 he studied for his M. Sc., as a private student, using Prof. Benade's laboratory for research. Then for the following two years he worked from the Forman College, receiving instruction under the scheme of inter-collegiate post-graduate teaching from Professors B. H. Willsden and M. B. Jones, both of the Government College. As in the B. Sc. it took him three years instead of two but not for the same reason. His Demonstrator's duties at two colleges usurped at the very least five hours a day and left him little leisure for study. So he gave himself more time by putting off appearing for one year. He took his M. Sc. in 1919 in which he was beaten by two others in total marks but stood highest in Physical and Inorganic Chemistry. His thesis in part fulfilment of the degree was on "The Effect of Absorbed Gases on the Surface Tension of Water."

In the same year he went to Europe on a Dyal Singh Scholarship, for which Professor

Ruchi Ram Sahni, a science member of the staff at Government College and also a member of the Dyal Singh Trust Committee, was largely responsible.

Dr. E. D. Lucas, who had been Principal after the retirement of Sir James Ewing, in fact, during most of Bhatnagar's Forman College days, writes "I have heard Benade, who worked with him most closely, say that S. S. B. was the Indian student most gifted with the powers of improvisation, thinking out a new problem, devising some new technique with tools and equipment. He knew how to use his hands, was not afraid of work and was not conceited though he had faith in himself."

On the 31st May 1915, Shanti Swarup married Lajwanti, the elder daughter of **Marriage** Rai Sahib Lala Raghunath Sahai, his father's old friend. Both Parmeshri and Raghunath Sahai, in early manhood, had expressed the wish and the hope that some day they would cement their friendship by forming a relationship by marriage through their children. The marriage of Shanti and Lajwanti was, therefore, a fulfilment.

The celebrations were held in Lahore and the marriage, which was in accordance with the Civil Marriage Act of 1872, was solemnized with Brahmo rites by Babu Abinash Chander Mazumdar. Both Shanti and Lajwanti declared that they were neither Hindu, Muslim, Sikh nor Christian. Grandfather Pearey Lal emerged from his solitude to participate in the marriage celebra-

tions of his ward Shanti, whose grandmother had died about three years before.

Their early married life was lived in rooms just inside the big entrance to the picturesque Raja Dhian Singh Haveli in the old walled city of Lahore, where the Dyal Singh High School was. The Haveli, situated in Hira Mandi, is the property of His Highness the Maharajah of Kashmir. Raja Dhian Singh was the great grandfather of the late Maharajah Sir Pratap Singh of whom the present ruler, H. H. The Maharajah Hari Singh, is an adoption.

CHAPTER II

S. S. Bhatnagar, B.Sc., M.Sc.

At last the great day came. On the 4th August, 1919 Bhatnagar was to sail for the West. Naturally excited at the prospect before him in which England and America loomed large, he looked forward rather than backward. Although he must have thought wistfully of what he was leaving behind, his eyes were on the look-out, and he was experiencing the thrill of adventure and travel. Above all the further studies and research in his chosen field of labour beckoned him. No, it could not be said that he was sad, for are not "the sorrows of departure for those who remain?"

The confusions of the first day aboard ship amused him and he was by no means confounded thereby. He just took it in his stride and very soon settled down, with his two student companions, falling in to quite new ways to which they were now to conform. The first meal aboard is often a trial to young Indians, to many of whom it is initiation in the table manners of the West and in the skillful use of knife and fork. These were soon mastered by Bhatnagar and his companions and they even

began to enjoy some of the unaccustomed dishes on the menu. Bhatnagar was a staunch vegetarian and to this day he has resisted even a taste of meat, whereas most "England returned" men have become meat-eaters. One of his companions was such a one, but the other was a very raw recruit¹ and had to go through the mill of ridicule from his jovial companions.

Bhatnagar made a friend from among his fellow passengers, an Englishman, who was agent in the East for the world-renowned biscuit firm of Peak Frean. He was short and lean, of about 45 years and extremely intelligent, with wonderful control over his feelings. It was very difficult to tell when he was pleased or annoyed. His observation was keen. He took a deep interest in radio activity and as soon as he discovered that Bhatnagar was a student of Science, volunteered a remark or two, on deck. From interest in radio activity he became interested in Bhatnagar himself who struck him as a rather unusual creature. It amused him to draw this creature out and get him to show unsuspected facets of his disposition. In fact the Biscuit Man was something of a psychologist and S. S. B. was beginning to know more about himself under the scrutiny of this tactfully probing individual. They greatly enlivened the tedious hours on board for one another and became good friends.

Bhatnagar had his own conception of what Paris, Berlin and London would be—America rather escaped his imagination. He was to travel

1. This was the present Sir Dattar Singh, famed for animal husbandry in the Punjab. The "Montgomery bull" is his creation.

overland from Marseilles and with the travelled Indian companion and the Biscuit Man, he broke his journey at Paris where they stayed for two days. He was staggered by Paris and did not quite know whether he liked it or not. It certainly was not as he had pictured it. However, it was the first European metropolis that he had seen and thus far he was impressed, for it was a new experience. The public buildings in their magnificence drew his admiration and the best houses were beautiful to look at. *The Champs Elysees* pleased him and also the people, vivacious and friendly. Their passports covered Germany, so off they went for two days. The time he spent in Germany was 'terrible'. He had had no good impression on arrival as in Paris. The aftermath of the war was evident, both physical and psychological. The people were by no means friendly to Britishers nor even to British subjects. Misery stalked the streets. Women and children, hungry—wailing and begging—beset them and dogged their footsteps until they had given a coin. At night Bhatnagar's companions took him the round of the *cafes* and there was dancing, drinking, love-making and all kinds of abandoned folly. His companions had seen this sort of thing before and were *blase* but Bhatnagar was sickened by it all and much depressed, thankful at the end of the two days to leave for London. *London*—another disillusion. He had read so much of the sylvan beauties of England—the countryside, her woods, her parks and gardens. His imagination was filled with expectation of, at the very least, a second Kashmir. But instead of a Jhelum he found a

Thames. The ship had entered the estuary before dawn and by the time they had gone on deck all that was green and fresh on the banks had been left behind. This was no Jhelum, not even a river; just a gigantic canal with its banks overbuilt. No sun, only mist; water in plenty, but its surface broken up with floating craft of every description, schooners, steam cutters, barges and dredgers. The barges glided silently in and out of the mist and voices were heard where nothing was seen. As the morning mists cleared a little, the banks less dimly displayed wharves and warehouses, warehouses and wharves—no end to them. Then as they approached the docks for ocean-liners the waters became more and more crowded with river craft, all seen emerging and disappearing in one of London's own mists. There was no fog on the day of Bhatnagar's disembarking but neither was there clear air nor sunshine. It was a dull grey day.

After the struggle of getting ashore and into the train that was to take them to London proper, there was further disillusionment ahead. As he sat in his comfortable corner seat he looked out upon a seemingly never-ending expanse of small slated roofs and interminable small chimneys. Where, Oh where, was the England of his dreams? How different it would have been had he landed at Plymouth, but of this he was unaware.

For once Bhatnagar was subdued and his spirits drooped. His boardship friend the Biscuit Man was with him, he had in fact invited this stranger in a strange land to stay in his flat at Knightsbridge until he had found a suitable place

to go to. They arrived at their destination about noon, and in the late afternoon Bhatnagar was taken by his host for a walk. When they had arrived at Marble Arch, on the Hyde Park side of the road, Bhatnagar was bidden to stay where he was while his host darted in and out of the traffic to get to the other side, to buy cigarettes. So this was London! For a moment he felt overpowered by the seething throng of people on the pavements and by the torrent of traffic on the road. He felt that his friend had been a very long time getting those cigarettes. Awful thought—he had probably come back and missed him. He must be looking for him, so he did what he should not have done and moved away from the spot, scanning the throng for the face of his friend. He had the postal address and could find his way back, though the prospect rather appalled him. Feeling forlorn, he stepped out with some diffidence to set off, on his own, for Knightsbridge. He was overtaken by his friend who had to run to catch up with him. They laughed and all was well. From that moment Bhatnagar began to get his bearings. For two days he accepted the hospitality of his friend at whose instigation he went to a swagger hotel where he paid £1 a day. This was a big sum to Bhatnagar but what matter, it was only for a week and then he would sail for America. When he went to the shipping office to book his passage he was bluntly told that not one berth was to be had—all had been taken over for demobilized Americans for weeks and weeks ahead. For ten days he strove for a passage, then giving it up as a bad job, he

cabled to the Dyal Singh Trust to ask if he might do his research work in London, following up his cable with a letter, explaining. They, of course, agreed. Before he had received the reply he fell in with an old friend, Prof. B. M. Jones, one time Science professor at Government College, Lahore, the very same whose Puck he had been asked to imitate. Prof. Jones was most helpful and took him to Prof. J. C. Phillips, the Head of the Physical Chemistry Department at the Imperial College of Science and Technology in South Kensington. But knowing of the great work done by Prof. F. G. Donnan, on his own subject of Surface Tension and Surface Properties, Bhatnagar's mind was bent on going to him.

Without introduction he presented himself at the Ramsay Laboratories of University College of which Donnan was Director and was shown into his office. Put at ease at once by reference to two other of his countrymen who that very day had appointments with him, the ice was broken and Bhatnagar spoke freely about his work and interests and of his great desire to work under him for his doctorate. Prof. Donnan gave him a problem to solve and asked to see any publications he might have on previous research. Having brought these with him he handed them over, then and there, and took away the problem given to solve. The problem was not easy, but he got certain results which he admitted were not very good. On the strength of the results, however, the printed account of former research and his own observation, Prof. Donnan took Bhatnagar under his care for the doctorate, tell-

ing him to work on his own problems in absolute freedom. He was given a large room to himself. As soon as Bhatnagar had settled down in suitable lodgings he worked with single purpose at his research studies for the D. Sc. taking as his subject Colloidal Chemistry and Emulsions and Emulsification.

The problem of finding suitable lodgings in London for an Indian student is by no means easy. It presents all manner of difficulties not all due to racial prejudice. Unavoidable differences exist in customs, taste in food, manners and mannerisms, social outlook and so on. All these combine to make a bridge to be crossed from either side by tactful and sympathetic adjustment of the one to the other. After a false start Bhatnagar settled happily in Maida Vale as the paying guest of Madame G. Madame was *cuisiniere*,¹ for she reflected the capacity of her accomplished husband, Chef of the Berkeley Hotel, in Piccadilly. Here Bhatnagar remained for more than a year in peace and comfort, during which time he made a systematic attempt to learn French, which he had daily opportunity to practise in conversation with his host and hostess. One of the very noticeable characteristics of Shanti Swarup Bhatnagar is that he never by any chance allows an opportunity to slip, big or small. This has contributed in no small measure to his success. Many a great scientist has not achieved success, although he may have made a name.

It was during Bhatnagar's first years in

1. A good cook.

London that H. R. H. the Prince of Wales visited University College and was shown over the Ramsay Laboratories by the Director. The Indian students, five in number, were at the time busy cooking their mid-day meal. Prof. Donnan, an Irishman of most genial disposition, knowing that H. R. H. would be interested, surprised the young Indians at their cooking. H. R. H. looked closely at their preparations and asked if he might have a taste. The students, thereupon, invited him and Professor Donnan to share their meal, which they did. Neither Prince nor Director made their exalted positions felt. They might all have been students at recess. The Prince had enjoyed himself and, on leaving, told them so.

Bhatnagar experienced his first English Christmas that year. The Christmas spirit of joviality was abroad. Rationing, however, in some foodstuffs was still in force, notably in butter and sugar. This, however, was a trifling matter. The war was over. That was everything and the people were in a happy state of release, free to abandon themselves to the conviviality of the festive season. Bhatnagar and some Science students celebrated Christmas evening in Prof. Donnan's rooms and after supper had a jolly time.

When the Christmas holidays were over it was a case of hard work until the summer holidays began. Bhatnagar at this time had the good fortune to be awarded a five years' Travel Scholarship by the Privy Council of Scientific and Industrial Research which amounted to £250 a year. He was overjoyed and began to plan his

vacation. Continental travel should begin with France, since he had to some extent mastered the language. The College year only lasted eighteen weeks. Six months for travel! He talked it over with Professor Donnan. They had become friends as well as master and pupil. His professor F. G. D. urged him to go to Germany as well, promising introductions to scientists telling him to be sure and see the Chemical Laboratories at the Berlin University in Bunsen Strasse of which Prof. W. Nernst was Head of the Physical Chemistry Department. The friend F. G. D., who was something of a *bon viveur* asked him to bring some lager beer from Germany. This, Bhatnagar was delighted to do.

He lost no time in taking advantage of his opportunity of making contacts with scientists abroad. So as soon as ever the college closed he was on a channel steamer bound for France.

In Paris he met Mademoiselle Mestre, Lecturer at the Sorbonne and through her he became acquainted with Prof. Jean Perrin who was Director of the Physical Laboratories and a Nobel Prize winner. The French claim the science of Chemistry as their own—French in origin, with Berthelot and Lavoisier as beginners and initiators. The walls and ceiling of the lecture theatre of the Sorbonne were covered with mural paintings depicting the deeds of great scientists. Here in the Sorbonne he was introduced to M. Urbain, inheritor of the apparatus of Le Chatelier, whose balances for accurately weighing a large bulk of goods, was shown. He also met Madame Curie and saw her laboratories.

He saw Prof. Langevain, whose magnetic theory he afterwards used in developing magneto-chemistry.

Arrived in Berlin, fourteen research students from University College of which Bhatnagar was one, stood outside the Physical Laboratories in Bunsen Strasse, waiting. They had sent in their letter of introduction to Prof. Nernst, from Donnan, each man with his nationality and subject of research was written therein. They waited for some time and at last Prof. Nernst himself appeared. "No" was the reply. "The wounds of the students were yet gaping. They would not like any Britishers to go round." So the fourteen left, crest fallen. Later on a note came addressed to Saha¹ one of the Indian students saying that he would allow him and his Indian colleagues to see the Laboratories because the last blow to the British Empire would come from India. (In 1935 Nernst was among those of Jewish blood who were expelled from Germany. England gave him sanctuary and when Bhatnagar met him again in 1936, Nernst was repentant, for his feelings for England had undergone a change.)

On the eve of their return to London, Bhatnagar and two others went to Munich to get the lager beer they had promised to bring for Professor Donnan. They gave their order for a caseful and sat at a *cafe* refreshing themselves until it was ready. Meanwhile a policeman came in and asked to see their passports, which did not

¹ Now Head of the Physics Department of the Calcutta University Science College.

cover Bavaria. So the three were marched off in custody and escorted to the nearest police station where they each were ordered to pay a fine of 100 marks. They then collected the case of lager and returned to London. Prof. Donnan asked the price of the beer, but they would not say, not allowing him to pay for it. They had all three contributed and wished him to accept it. At last he consented, but persisted in his question about the price. He wanted to know what was charged for lager in Germany now. What had it cost them? They laughed and added to the sum their three fines. "Good gracious" said he "that is 300 marks more than it used to be."

In the early spring of 1921, I happened to be in London having come on a short visit from Devonshire and I lost no time in getting into touch with S.S.B. We met in a restaurant and had a meal together. He was bubbling over with all sorts of things and after the meal he took me to University College and showed me his room. It was a pleasant meeting for us both. I invited him to lunch with me at Larkhall Rise, Wands-
worth near Clapham, where I was staying. When I began explaining how to get there, he stopped me. "That's alright, I'll find out." So all I had to do was to direct him from the station to Larkhall Rise. He had got his bearings in London and could find his way anywhere. We met again at the Indian Students' Union, where I was to read "The Physicians" a play of my own writing, an allegory with "Bharatvarsha" as a sick man. It had, in fact, formerly been entitled *The Sick Man* and was more or less a

dramatization of the Montague Chelmsford Report, founded on an article by Sir Jogendra Singh,¹ entitled *The Sick Man*. A heated discussion followed the reading in which S.S.B. was Leader of the Opposition. The late Dr. B. L. Bhatia of Lahore was present and also T. M. Desai, from Baroda, in whom I had staunch supporters. This was the last time I saw S.S.B. to speak to before he left for India, but I did *see* him again—from the inside of a bus. It was in a very busy part, as far as I remember, in Tottenham Court Road. There was his familiar figure—stepping out with the self-confidence and the detached look of a Londoner, surefooted and equal to crossing any road full of traffic.

After spending the summer on the continent his first impressions were wiped out. He still felt that Paris was more beautiful than Berlin, but not so clean within doors. Berlin was not so good to look at but scrupulously clean everywhere. He had grown to like London better than either. He had, in fact, become a Londoner.

In April of that year the Colloquium was held at which he was to give a discourse as a thesis for his doctorate. On the strength of his publication on Surface Tension, he was exempted from taking the Ph.D. a pre-qualification necessary for a D.Sc. For the doctorate his research had been on Colloidal Chemistry, and Emulsions and Emulsification. The audience at the Colloquium was composed of professors, research students

¹ Member for Education, Health and Lands on the Viceroy's Executive Council, (now deceased).

and experts on the subject of exposition. Sir William Bragg presided and Prof. Donnan sat in a conspicuous place.

Bhatnagar, well aware that this was the climax of his student career, was very much on his mettle. He delivered the thesis to his own satisfaction. What then was his amazement when Professor Donnan rose and riddled it with shattering criticism. Bhatnagar rose to defend his thesis and at the end Donnan embraced him. Sir William Bragg patted him on the back and said his defence was wonderful and he deserved to be a Doctor of Science.

It was not long after taking his D.Sc. that he received an offer from Benares Hindu University. Would he become University Professor of Chemistry? He cabled to Pt. Madan Mohan Malaviya, to accept

This, of course, meant relinquishing his travel scholarship, so he made the most of what remained of his opportunity for further studies and research on the continent. When the College closed he once more crossed the channel. This time he paid but a fleeting visit to France and stayed longer in Germany.

In Berlin he did research work at the Kaiser-Wilhelm Institute, where he worked under Professor Haber. He it was who had introduced poison gas in the last war. He had also invented a process for synthetic ammonia. Prof. Haber had lost two sons in the war and was broken-hearted. Being a Jew, he was, in 1935 among those who had been ejected from Germany.

Eventually he died and it was suspected that he had committed suicide.

Another German Professor with whom Bhatnagar worked was Prof. Freudlich, an expert on Colloids. He also was a Jew and suffered expulsion.

“In the last two years almost all those German scientists who are of the Jewish race have had to leave their country. The National-Socialists have been led, by their belief in a racial theory, to eject very many of Germany's ablest scientists. Science in Germany will suffer not only by the loss of these men but the reduction in the prestige and facilities for work of those that remain. It is now the Professor of Military Physics rather than the Professor of Atomic Physics who has the prestige.

There is no doubt that amid the contributory causes of the anti-semitic movement was the necessity to provide more jobs for the rest of the professional classes. The Nordic racial theory of the Nazis has, therefore, the advantage of obscuring to some extent the practical reasons for their actions. And this development is no accident. It is a part only of a larger movement, and the larger movement is essentially anti-scientific. Another part of the movement includes the boost of the small manufacturer against the trust, and the small retailer against the chain store and the co-operative. It also includes the giving of heavy subsidies to the peasant to enable him to continue his inefficient method of food production. Another important part is the attempt to replace machinery by manual labour wherever

possible. In fact, the rapid movement today in Germany and elsewhere towards nationalism and self-sufficient capitalism means giving up some of the increase in material prosperity of the workers, which is made possible by Science. The Nazis do not grudge the loss of so many of Germany's best scientists, because in their heart they know that they do not need their help in the way they want to go.

As a result of this anti-scientific trend, we see also in Germany a general anti-intellectual tendency developing. This leads to an enthronement of the emotions rather than reason, and the mystic soul of the nation is made into a god. Because the Nazis find that they cannot enjoy the fruits of scientific progress, they try to believe that the grapes are sour. I believe that it is therefore true to say that the overthrow of reason by emotion in Germany today has less to do with the national temperament than with the amount of unemployment, and particularly with the amount of middle-class unemployment. This anti-machinery movement, with the emphasis on the man in a small way of business, is very noticeable in many parts of the world. It tends to become violent when there is much middle-class unemployment, and then the situation is ripe for Fascism."

These lines occur in the *Frustration of Science* by Prof. P. M. S. Blackett, F. R. S., in an article founded on a broadcast talk, in March 1934.

While Bhatnagar was still at work in the Kaiser-Wilhelm Institute in Berlin, he received a cabled reminder from Benares, signed by Pt.

Madan Mohan Malaviya. It was opportune, for in his zeal for research work he was oblivious to the passage of time. He cabled back to say he was coming. It was a wrench, but he had promised, so go he must.

As soon as he could he wound up his work and took leave of his German friends. He had enjoyed the five years' travel scholarship for little more than a year.

In England, it was just a round of farewells to friends, where the one he most regretted taking leave of was his good friend and teacher, F. G. Donnan.

Once the wrench of parting was over and the ship was well under way, Bhatnagar began to look forward to the first sight of the shores of India, to seeing his people and his infant son. Beyond these—Benares. Benares and further research. For this he longed.

Among his fellow passengers were Mrs. Annie Besant and Mr. M. A. Jinnah. When, on nearing the shores of India, the Indians on board gathered on deck to sing *Bande Mataram*, Mrs. Besant joined them.

CHAPTER III

S. S. Bhatnagar, D. Sc.

Pt. Madan Mohan Malaviya was then Vice-Chancellor of the Benares Hindu University. As yet, Bhatnagar had not met him, though of course he knew of him as one of India's notable personalities. When a University Professor was needed at Benares, Pt. Malaviya had written to Sir C. V. Raman, Sir J. C. Bose and Sir P. C. Ray, who all happened to be in London at the same time as Bhatnagar. In consultation they agreed upon S. S. B. and it was on the strength of their recommendation that he received the offer. It was one out of four, that he had had. He did not hesitate to accept Benares in preference to the other three as it gave him more scope for research. The other offers were from Dehra Dun for Forest Research, from the Dyal Singh College as Principal and from the North Western Railway as analytical chemist. In addition there had been two feelers, one from Sir J. C. Bose as Superintendent of his Institute at Calcutta and the other from Sir Asutosh Mukherjee as Professor of Physical Chemistry at Calcutta.

Bhatnagar avers that his best work was done at Benares where he had an open field for research

—pure research, his own laboratory and no administration. His early 'bachelor' days at Benares were spent with the late Dr. K. K. Mathur, University Professor of Geology, who was an intimate friend. The closeness of the friendship continued, even after he had separated from him to live a family life in a separate house. His wife and child were sent for as soon as he had secured residential quarters.

A generous and open-hearted action, typical of Bhatnagar, was when he took over from Prof. M., an elderly man of about 55, who had been Head of the Chemistry Department. As he handed the keys to the new professor tears welled up in his eyes.

"Why are you sad? What troubles you?" asked S. S. B.

"I have held these keys for fifteen years."

"Then hold them still."

"I cannot do that. It is you who must have them now. You are Head of the Chemistry Department."

"That's alright. Keep them. I'll put it up to the Council"—which he did. There was considerable discussion on the point but Bhatnagar insisted. Let Prof. M. keep the keys. Let him continue as Head of the Chemistry Department. It was a small matter and he would gladly serve under him. So it was decided that the keys should remain with the elderly professor who was still to be called Head of the Chemistry Department. At the close of the meeting the professors, pleased at Bhatnagar's action, gathered round him while Pt. Malaviya hugged him.

From this time he became popular in the College and Pt. Malaviya took particular interest in him; as for Prof. M., he became S. S. B's devoted admirer. Here he met again his old friend and science teacher, N. N. Godbole, who being on the staff was now his colleague. They renewed their friendship and had cordial relations.

S. S. B. was generous to students who were eager to take Science. On occasion he paid for stipends out of his own purse to promising but impecunious youths. His laboratory soon got a reputation in the University. "You must see Bhatnagar's Laboratory" was one of Malaviya's customary sentences to visitors.

Bhatnagar's poetic strain has already been referred to. He is given to occasional versifying in Urdu. It was he who wrote the Benares University song—*Alma Mater*, two stanzas of which are given below in free translation that is prosaic—prosaic in its literal sense. It will give an idea of his love for the University and its founder, Pandit Madan Mohan Malaviya.

ALMA MATER

Oh great citadel of Learning!¹
 By Barna and Assi,² softly flowing
 Bathed in by Kabir and Tulsi— •
 A tranquil lake of poesy
 This citadel of Learning.
Lovely, lofty, in beauty upstanding
This citadel of learning!

1. Benares proper.

2. Barna (or Varuna) and Assi, two rivers from which the name of Benares has been derived.

Oh new citadel of Learning¹,
 By sublime and great endeavour
 Our Malaviya, India's own devotee,
 Has brought into the light of day
 Our new citadel of Learning !
Lovely, lofty, in beauty upstanding
Our new citadel of Learning !

Bhatnagar greatly enjoyed his college work in which research predominated. He had only two hours a day, teaching; the rest of the day was spent in pure research, mainly in colloids, Geo-Chemistry and Photo-Chemistry. Research students came to him from all parts of India. Some outstanding men who received their doctorate under him were Dr. Mata Prasad, now Head of the Chemistry Department, Royal Institute of Science, Bombay; Dr. S. S. Joshi, now Principal, College of Science, Benares Hindu University; and Dr. D. L. Shrivastava.

In 1923 Bhatnagar was sent as delegate to the British Association's Annual Meeting to be held at Liverpool. The prospect fired his imagination. Had not the British Association been founded for the advancement of Science? Did not the Association pay grants in aid for Research? Did not delegates attend the annual meetings from all parts of the world? He read all he could to enlighten himself on the history of the Association. He now looked upon his journey as a pilgrimage—a new kind of pilgrimage—to Science, Science enthroned, Science articulate. The avowed object of the Association to

**Delegate to
 British
 Association
 in Liverpool.**

1. The Benares Hindu University.

diffuse wide-spread scientific knowledge by holding the annual meeting always at different centres, appealed to him greatly. In the past such meetings had been held even overseas—in Australia in 1914, at Winnipeg in 1909, at Toronto in 1889, at Montreal in 1884. Why not some day in India? Why not at Benares? It was in a state of ecstatic anticipation that Bhatnagar set sail for Liverpool. Arrived on the scenes he found many old friends and among them Prof. Donnan. Bhatnagar was asked to sign the register of distinguished visitors. He did so reluctantly, since he did not consider that he came under that heading. Among the distinguished visitors whom he met were Prof. Neils Bohr, a Dane and Prof. G. N. Lewis, from America.

Sir Ernest Rutherford (later Baron Rutherford of Nelson) O. M., F. R. S., was president. His address "gave him an opportunity for expressing his views on various aspects of human activities, particularly that of co-operation between industry and scientific research. It contained many succinct suggestions."

In those days broadcasting was in its infancy and Rutherford was the first president of the British Association to broadcast his address.

He referred to the last time that the British Association had met in Liverpool in 1896, under the presidency of the late Lord Lister.

"The visit to your city in 1896 was for me a memorable occasion, for it was here that I first attended a meeting of this association, and here that I read my first scientific paper. But, of much more importance, it was here that I

benefitted by the opportunity which these gatherings so amply afford, of meeting for the first time many of the distinguished scientific men of Great Britain and the foreign representatives of Science who were the guests of this city on that occasion."

He went on to speak of other reasons why the year 1896 had been memorable. It was the beginning of "what has been aptly termed the heroic age of Physical Science." Another advance in this year was that of applied physics and the successful transmission of signals for a few hundred yards by electric waves which had been made in England by Marconi. "It is startling to recall the rapidity of the development from such small beginnings of the new method of wireless inter-communication over the greatest terrestrial distances. The rapidity of these technical advances is an illustration of the close interconnection that must exist between pure and applied science if rapid and sure progress is to be made... In this age no one can draw any sharp line of distinction between the importance of so-called pure and applied research. Both are equally essential to progress, and we cannot but recognise that without flourishing schools of research on fundamental matters in our Universities and scientific institutions, technical research must tend to wither." He went on to speak of radio activity and the hidden stores of energy in the atom¹. He felt that "inspite of the slackening

1. The writer regrets having been unable to secure Lord Rutherford's address to quote from it in relation to atomic energy that is of such vital interest in these days (June 1947).

of advance during the war, there has never been a time when the enthusiasm of scientific workers was greater, or when there was a more hopeful feeling that great advances were imminent—I feel it is a great privilege to have witnessed this period.”

At one of the subsidiary meetings there was to be an international discussion on Emulsions, initiated by Bancroft, an American delegate, who in giving his theory attacked Donnan and his school. Dr. Bhatnagar was asked to reply. He showed that Bancroft's theory was untenable and asserted that the solution lay in the empirical rules which were drawn up by himself, that the future research that will solve this mystery will be on the fact of electro-lytes on Surface Tension of the film and water in oil.

“But even the experienced in Science will benefit by consultation with each other; for there are different degrees of experience, and no solitary industry or talent can ever hope to equal the power of combined wisdom and concerted wisdom and concerted labour. Above all, consider, gentlemen, the excitement to exertion which will be felt by those who are solicited to undertake an inquiry at one of these meetings, and pledged to produce the investigation at another.

The greatest minds require to be urged by outward impulses, and there is no influence more powerful than that which is exercised by publicly esteemed bodies of men.”

These words were spoken in a long speech by Vernon Harcourt, F.R.S., at a general meeting at York on Monday the 26th of September 1831.

when he proposed the foundation of the British Association for the advancement of Science.

The influence on Bhatnagar and also on Bancroft and all who partook in the discussion on Emulsions, of the "publicly esteemed body of men . . . at one of these meetings"—more than ninety years after the above words were spoken—must have been all powerful and the advancement of Science in Liverpool at the close of the session must have taken place.

Bhatnagar was not one of those who go about with their eyes shut, so one day soon after leaving Liverpool he found himself writing to the Vice-Chancellor of the University of the Punjab, at that time Sir John Maynard, applying for the post of Director of the University Chemical Laboratories, then under construction and nearing completion. He had been reading *Nature* in the reading room of University College when his eye fell upon an advertisement for the directorship, above mentioned. He immediately applied. It was not until he had posted the letter that he realized what leaving Benares would mean. There, it was a case of pure research, but as director of an institution his research would be hampered by administration. Opportunities, however, for the development and furtherance of research work would be greater, and he was not a man to allow any opportunity to slip. Writing to Pt. Madan Mohan Malaviya, telling him what he had done, he softened the news by saying that he did not suppose he had any chance of being appointed, though in his own mind he was fairly confident that he would.

Applications for this prize post were numerous and came from far and wide; from the United Kingdom, the Dominions and from all over India. Two selection committees of experts sat. On the English one were Sir Herbert Jackson, K.C.B., F.R.S., Sir Jocelyn Thorpe and Sir James Walker; while on the committee in India were Sir P. C. Ray, Prof. J.L. Simonsen and Prof. H. R. Watson. Eventually three men were in the running: Willsden, Cavanagh and Bhatnagar. When the matter came before the Professors' Committee in Lahore, with Sir John Maynard in the Chair, Cavanagh was ruled out, and the contest lay between Willsden and Bhatnagar.

On his return to India Bhatnagar was met in Bombay by Rai Sahib Lala Raghunath Sahai who told him the ins and outs of the final contest. When he heard that the choice now lay between himself and Willsden he said he would withdraw. How could he oppose his old teacher? Willsden at the moment was virtually in charge, supervising construction. The building had been started in 1922 under him. During Bhatnagar's absence in England his father-in-law had been busy on his account. He told S.S.B. of the controversy going on between supporters of the rival candidates and asked him to go to Lahore and show himself and also to call on Sir John Maynard. This he refused to do, and in spite of his father-in-law's entreaties he went straight back to Benares and awaited the results, having yielded to the persuasion not to withdraw.

Meanwhile he was rather unsettled and Pt.

Malaviya was uneasy at the possibility of losing him.

An incident after his return from England is worthy of record. When in Liverpool as delegate to the British Association, a noted English Scientist, Prof. H., had approached him and made a complaint against one of his colleagues at Benares. A certain person in the Benares Hindu University had lifted hunks from his book on Electrical Engineering and printed the matter as his own. Prof. H. was naturally much annoyed. To the money part of it he was indifferent, but in common courtesy, if not honesty, had his findings been used, at the very least, they should have been acknowledged. Would he very kindly take a letter from him to Prof. X. intimating the same, and asking him to make an apology to himself and also a public acknowledgment of the source of much that was in his book. Prof. H. warned X that if the offence was repeated he would feel obliged to get legal redress. On his return to Benares, Bhatnagar met Prof. X and handed him the letter from Prof. H. What was his amazement when having read the letter X calmly tore it into shreds and said "Now where is the evidence?" S.S.B. leapt on him and gave him a good drubbing. When he left the unhappy X, he fell in with an Englishman, Principal of the local engineering college. Bhatnagar bore the signs of his agitating clash with X. Principal K, asked what had happened to him, whereupon he told the story.

"What would you do to such a man in England?"

"Give him a good licking " replied K.

"I have !"

Encouraged by this encounter, Bhatnagar returned to the fray and let X have it again, but this time in wordy castigation that went deeper than surface blows. X said he would report his behaviour to the Vice-Chancellor, which he did. Bhatnagar was sent for and the Vice-Chancellor asked for an explanation.

"If you ask me as Vice-Chancellor I refuse an explanation and suggest you initiate an enquiry. But if you ask me as Madan Mohan Malaviya, I will tell you all about it."

"I ask as Malaviya."

So the whole story came out. X was forthwith sent for and in the presence of them both he repented of his plagiarism and then and there wrote the letter that had been demanded of him by Prof. H. It was handed to Bhatnagar and X withdrew. The sequel was the resignation of Prof. X.

In Lahore at the Professor's Committee meetings there was heated discussion upon the comparative qualifications of Willsden and Bhatnagar for the post of Director of the Chemistry Laboratories.

Prof. Willsden in age and experience outweighed Bhatnagar, whose passion for research and remarkably brilliant career up to date was weighed in the balance. But how was it possible, asked his opponents, for a man who only the other day was a demonstrator, to become University Professor of Science and Director of the University Chemical Laboratories? The idea was ab-

surd. Sir John Maynard had no personal knowledge of Dr. Bhatnagar and he remarked, as a grievance, that Dr. Bhatnagar had never even called upon him, to which both Dr. Lucas and Carter Speers took exception. Bhatnagar could stand on his own feet and merit. There was no need for him to push himself forward to attract attention. One of Bhatnagar's opponents remarked that perhaps he was a poor lecturer and that was why he kept in the background. At this Dr. Lucas leapt to his feet and, in one of his characteristic righteous outbursts, said that Bhatnagar was "probably a better lecturer than any one of us!" The matter of selection was put to the vote. *A draw*: Sir John Maynard refused his casting vote. *Deadlock*. Sir John Maynard decided to put the matter to the Syndics. Before the second Syndicate meeting came off at which the final decision was to be made Willsden withdrew. *Deus ex machina*. Sequel—Bhatnagar, unanimously.

In his opinion, he qualified for the post at Benares, where his professional career had begun and where he had free scope for research and teaching; both essential requirements for the University Professor of Physics and Chemistry who was also to direct the University Chemical Laboratories at Lahore.

At Benares Malaviyaji had been a constant source of encouragement and inspiration. "Merely to see him," says S.S.B. "was an urge to do something."

CHAPTER IV

S. S. Bhatnagar, D.Sc., O. B. E.

As Director of the University Chemical Laboratories, at Lahore, Dr. Bhatnagar proved himself a capable administrator. There was no lack of research students. They flocked to the laboratories for admission as soon as they were opened and in full swing. Some of the Benares research students followed S. S. B. and among them was Dr. Mata Prasad, who became a demonstrator in the University Laboratories. He had refused offers at Benares that would have brought him more remuneration, but in his zeal for research and his devotion to Dr. Bhatnagar he did not hesitate to brush them aside. He is now Professor of the Royal Institute of Science, Bombay.

Under Bhatnagar's forceful and inspiring leadership, research work was carried on with zeal and with devotion, both to the work in hand and to Doctor Saheb himself. As "Doctor Saheb" he was known to every person in the laboratories from the humblest menial to the highest research scholar.

The Laboratories are pleasantly situated, flanked on one side by University Hall, standing

in its ample grounds, while on the other, across a side road, are the pleasure gardens known as *Gol Bagh*. Opposite the entrance the *Zamzamah* stands—the old cannon immortalized by Rudyard Kipling in *Kim*;—midway across a broad stretch of the Mall, and beyond it is the Museum, the *Ajaib Ghar*—House of Wonders, also a part of *Kim*.

When Dr. Bhatnagar left Benares to come to Lahore, he lived *en famille* at Nabha House, an old large and rambling bungalow, in a real garden—not a 'compound.' This had at one time been the Lahore residence of H. H. the Maharajah of Nabha, a small Indian State in the Punjab. Here he contrived a home atmosphere that was rather unusual in the Indo-European houses of those days which were furnished in blind would-be imitation of the British and at the will and discretion of furniture dealers. These houses were more showy than comfortable. On entering the Bhatnagar's bungalow one found oneself in a lounge with really comfortable easy chairs and good firm tables. In its rather massive furniture, its comfort and spaciousness, one was reminded somewhat of cosmopolitan Bombay.

During their fifteen years in Lahore, the Bhatnagar family had four homes. The second was on the Lower Mall, barely a stone's throw from Doctor Saheb's work. Going to and fro he used to take a short cut through the *Gol Bagh* and after crossing the Lower Mall on his way home he stepped right into his own compound. This really was a compound and no garden. At the back of the house was a large courtyard

somewhat typical of old Indian homes. Like Nabha House this also was a bungalow but built in Indo-European style. The pleasures of Nabha House and its gardens were relinquished without a pang by S. S. B. because he was now near his work, practically next door. That, to him, was everything.

At the Laboratories, at the start, he carried on research in his own subjects of colloidal chemistry and photo-chemistry. But very soon Applied and Industrial Chemistry had to be got down to as some leading industrialists and agriculturists came to him for help in their problems. The late Sir Ganga Ram was among the first. This Grand Old Man of the Punjab, the much loved retired engineer, who had turned neo-agriculturist, village planner and philanthropist, wanted Doctor Saheb to help him develop uses for *bagasse*, the peelings of sugar cane, which combined with molasses made food cake for cattle. Then, sisal and agave for ropes, and problems as well in the manufacture of ice, since Sir Ganga Ram dabbled also in industry. The late Sir Daya Kishen Kaul also consulted him about problems of his resin manufacture, at Jallo. He was able to help Lala Harkishen Lal in his white lead problems and in the utilization for industrial purposes of spare electric power from the Lahore Electric Supply of which he, L. Harkishen Lal, was chairman. These were the small beginnings of the remarkable researches in Industrial Chemistry for which Bhatnagar later became famous. His pure research led to the brain-wave by which he found in a flash the solution of the

'mud problem' of the Attock Oil Co. at Rawalpindi. This brain-wave resulted in a ten years' scheme for research in petroleum and allied subjects endowed through the munificent gift to him by Messrs. Steel Bros. & Co. Ltd., London. This, so far, is the most spectacular success achieved by Dr. Bhatnagar, to be related in detail later. Incidentally, his solution of the 'mud problem' in oil was proof of the rightness of his insistence upon rigorous research in Pure Science as the only possible basis for Applied Science in the cause of industry. His own concentration on colloids was the secret of his solution of the oil problem.

In 1927 he initiated studies in Magneto-Chemistry. This was something entirely new. Certain difficulties in colloid chemistry were overcome by knowledge of the magnetic properties of matter.

In 1928 he invented an instrument, in collaboration with one of his research men, that eventually was called the Bhatnagar-Mathur Magnetic Interference Balance, one of the most sensitive of instruments for measuring magnetic properties and the small differences in susceptibilities. This balance was exhibited at the Royal Society *soiree* in 1931, manufactured by Messrs. Adam Hilger, Camden Town, London.

Prof. Arthur Compton of the Ryerson
Cosmic Ray Expedition. Physical Laboratory of the University of Chicago had been invited by the University of the Punjab to conduct researches and experiments on his own subject of X-rays. On July 14, 1926 he wrote a letter to

Dr. Bhatnagar. of which the following is an extract:

"...Mr. Ishwar Das, Registrar of the University has asked me to communicate with you regarding the research equipment. Prof. Seth of the department of physics, in the Government College. has written me regarding the facilities available in his laboratory, and it seems that, with what I can bring with me from this country, there should be no difficulty along that line. My experiments will be concerned chiefly with X-rays; though I plan to perform an experiment on the penetrating cosmic rays at some mountain lake in the Kashmeres immediately after my arrival in the Punjab..."

The cosmic ray expedition was planned and financed by the University of the Punjab, members of which, in addition to Prof. Compton were Prof. Benade, Dr. Bhatnagar and Dr. Nazir Ahmad. Some science students also accompanied them. Mrs. Compton had come out to India with her husband and their son aged fourteen. They also were of the party.

Arrived at Gulmarg, in Kashmir, they planned their trek up to a lake in the Tosh Maidans that would serve their purpose. Mrs. Compton elected to accompany the expedition with her son. They had taken with them provisions for one month and also the instruments that Dr. Bhatnagar had had made for the experiment. Prof. Compton had with him his own equipment that he had brought from America.

It was a stiff climb to the lake that lay at an altitude of about 17,000 feet and bitterly cold.

However, they were all fit and greatly enjoying the adventure, particularly the nightly halts. They had done themselves well and Prof. Compton had also brought some provisions from America. This went into the common stock and they ate with relish in the cold temperature after their arduous days. Mrs. Compton stood it well, and her boy did justice to the sweets they carried with them. Taking it by and large he had a really good time.

Arrived at Tosh Maidans they pitched camp. Soundings were made in the lake with an electrometre to a depth of 250 feet, taking measurements of the intensity of cosmic rays. This went on continuously by day and by night for more than a week—the four of them getting up two by two in rotation at night to take the readings. The cold was hard to bear and eventually a blizzard put a stop to their work. Their cook had died of heart failure and they returned to Gulmarg on their way back to Lahore, having shown that the intensity of cosmic rays decreased as the ionization chamber (measuring instrument) went deeper and deeper. Before they struck camp they had the thrilling adventure of being lost and losing one another. For three or four hours they shouted to attract each other and by slow and rather terrifying degrees they converged and found themselves, happily, above their camp. They celebrated the joyful re-union by sliding down on the snow of the very steep mountain side.

In 1927 the Indian Science Congress was

**Indian
Science
Congress.**

held in Lahore with S. S. B. in charge of arrangements as Local Secretary. Delegates flocked in from every part of India, and it was his responsibility to see to it that all were suitably housed and entertained. In this he himself took a share by having a house party of his own particular friends. Sir Malcolm Hailey, then Governor of the Punjab, was Patron and presided at the inaugural meeting at which the late Sir J. C. Bose gave the presidential address. The Chairman of the Reception Committee was Sir Geoffrey de Montmorency, then Vice-Chancellor of the University.

The nearness of his house in these busy days completely justified itself. His home was a refuge for many more than his own guests. Not only in his laboratory was Bhatnagar a magician. In his own home, by a wave of his hand he had transformed the court-yard at the back of the house into a most elegant and spacious dining hall. The walls were of canvas and the roofing a *shamiana*,¹ with *kanats*² used, as desired for passages and partitions. The long table was always laid to utmost capacity. It could accommodate fifteen and although the house guests numbered no more than eight, there was never a vacant place at meal times. The writer had been imported by S. S. B. from the Kangra Valley to decorate University Hall for the banquet at the close of the session, so it was also her privilege to sit at his hospitable board. These meals of assembled scientists, in jovial mood, made

1. A *Shamiana* is a canopy raised on poles.

2. *Kanats*—Canvas screens.

pleasant diversion from the dignities and the solemnities of Congress proceedings.

To decorate University Hall for a banquet was a problem. It was decided to create an illusory ceiling to obliterate the chilling height of the Hall. This was done by festoons of orange leaves fixed to the long rods for electric fans that were at just the level the ceiling ought to be and on these festoons were suspended hundreds and hundreds of oranges.

The banquet was attended by more than 200 guests and many notable persons, scientific and otherwise were among them. H. E. Sir Malcolm Hailey was the guest of honour, the post prandial speeches were excellent, particularly those of His Excellency and of Sir Martin Forster, who responded to the toast of visitors. Sir Martin referred in his speech to Bhatnagar as "that alpha particle," a jest that was greatly appreciated.

No sooner was the Science Congress over than the Chemical Laboratories again began to hum to the tune, and pace, of the 'alpha particle.'

It was about this time that Bhatnagar began his utilization of wastes for industrial products. Jute and Jute dust, molasses, cotton waste, bamboo waste, cocoanut shell and fibre, were all put to good use.

Jute waste in the form of used sacks led eventually to remarkable products from hessian proper. Many substitutes were made from it, notably for corrugated iron roofing and for plywood. This solidifying of hessian was intend-

**Utilisation
of Wastes.**

ed for rural uses, mainly for roofing in villages. Work was also done at the waterproofing of mud plaster and the solidifying of mud tiles.

In September 1931, Bhatnagar went to England as delegate to the British Association Centenary and the Faraday Centenary. With these he combined the Empire Universities Congress at Edinburgh; he was away from India for four months and was accompanied by his wife.

The Centenary of the British Association drew a great number of delegates from all countries, the occasion having been made international. The president-elect was Lt. General the Rt. Hon. Jan Christian Smuts, P. C., C. H., F. R. S. The celebrations were held variously at Burlington House, and the Royal Institution and covered the period of a week.

The inception of this great Association in 1831 is worth recalling.

At that time¹ "War in England had been (as in the present century) the pre-occupation of every man, its aftermath, too, exhibits certain obvious parallels with the circumstances of recent years." . . . In 1821 the Yorkshire Philosophical Society had been founded and "its object was to promote Science in the district by establishing a scientific library, scientific lectures, and by providing scientific apparatus for original research.

1. This, and following passages within quotation marks, is from *The British Association...A Retrospect*; by O.J.R. Howarth, O.B.E., M.A.

It's more particular object was to elucidate the geology of Yorkshire."

Sir David Brewster, the prime mover in bringing into being the British Association, was one of a group of scientific men who 'spoke out' from about 1826. "The return of the sword to its scabbard" wrote Brewster, "seems to have been the signal for one universal effort to recruit exhausted resources, to revive industry and civilization and to direct to their proper objects the genius and talent which war had either exhausted in its service or repressed in its desolations. Can we behold the science of England, the vital principle of her arts, struggling for existence, the meek unarmed victim of political strife?"

On February 23rd, 1831, Brewster wrote to John Phillips, the Secretary of the Yorkshire Philosophical Society, as follows :

"Dear Sir,

I have taken the liberty of writing you on a subject of considerable importance. It is proposed to establish a British Association of Men of Science similar to that which has existed for eight years in Germany, and which is now patronised by the most powerful sovereigns in that part of Europe. The arrangements for the first meeting are now in progress, and it is contemplated that it shall be held at York as the most central city in the three kingdoms.

"My object in writing to you at present is to beg that you would ascertain if York will furnish the accommodation necessary for so large a meeting, which might perhaps consist of above

100 individuals if the Philosophical Society would enter zealously into the plan, and if the Mayor and influential persons in the town and in the vicinity would be likely to promote its objects.

“The principal objects of the Society would be to make the cultivators of Science acquainted with each other to stimulate one another to new exertions to bring the objects of science more before the public eye and to take measures for advancing its interests and accelerating its progress.

The Society would possess no funds—make no collection and hold no property—the expenses of each Anniversary Meeting being defrayed by the Members who are present.

As these few observations will enable you to form a general opinion of the object in view, I shall only add that the time of meeting which is likely to be most convenient would be about the 18th or 25th July.

I am, dear Sir, ever most truly yours,
D. Brewster ”

The sequel was that the “Lord Mayor and some others of the magistrates would have great pleasure in doing anything that lies in their power to promote the objects of the Society mentioned by Dr. Brewster, and they rejoice that York is fixed upon as the place for holding its meeting.”

The Yorkshire Philosophical Society is looked upon as the mother society of the British Association. The word *philosopher* was used in those days interchangeably with *scientist* which

may throw light on the fact that a Ph. D. is the pre-requisite for a D. Sc.

The Faraday Centenary was to celebrate Faraday's discovery of the relationship between electric current and magnetism. The chief host was Sir William Bragg, O.M., K.B.E., F.R.S., Director of the Davy-Faraday Institute. Delegates met in Faraday Hall, where the great scientist himself had lectured. Faraday's own laboratories had been arranged as in his life time. Sir William Bragg was then living in Faraday's flat where some of the delegates had the privilege of having tea with him and among those was Bhatnagar. The Faraday celebrations lasted for a week. A tremendous gathering of scientists had assembled in London and during the fortnight that covered the two centenary celebrations many vital contacts were made between men of widely separated countries and continents.

During his stay in London, Bhatnagar haunted University College where an old student had always the privilege of using a room for research work. In the same year he attended the Empire Universities Congress held at Edinburgh opened by the Hon'ble Mr. H. A. L. Fisher, Minister for Education. Other delegates from India were Dr. A.C. Woolner, Sir S. Radhakrishnan and Sir Hassan Suhrawardhy. A visit to Aberdeen was arranged and also to Glasgow, where they were warmly received and entertained by the Mayor. At a dinner in honour of the visitors Sir S. Radhakrishnan made a memorable and eloquent speech.

One of the most remarkable happenings of the career of Bhatnagar occurred in 1933. The Attock Oil Company of Rawalpindi were in difficulties. In their drilling operations for oil, mud that came into contact with saline deposits, set into a solid mass which hardened further, rendering all drilling impossible. The story cannot be better told than by P. Carter Speers, written in the *Journal of Scientific and Industrial Research* in its issue of April 1943.

“It was during this period that Dr. Bhatnagar demonstrated that the very first requirement of an Industrial Chemist is a very thorough grasp of theoretical Chemistry. How well, I remember, how it all began! The Attock Oil Company was faced with great difficulty due to the coagulation of mud in their drilling operations when they encountered salt deposits. The difficulty seemed insuperable and much money and effort had been spent to overcome this difficulty. The University Chemists were consulted. Dr. Bhatnagar, Dr. Dunnicliff and I sat down with the Company's chemists to discuss the problem. Dr. Dunnicliff suggested several chemical methods for meeting the difficulty which seemed impractical; as Professor of Technical Chemistry, I suggested various mechanical ways which were even more impractical; but the theoretical chemist—Dr. Bhatnagar—insisted from the beginning that it was a simple problem in Colloid Chemistry and before long he convinced us all that he was right. Before the day was over, he had demonstrated his idea in the laboratory and before

the week was over it was being tested in the oil field. Dr. Bhatnagar's method? Some highly complicated scientific *legerdemain*? Not a bit of it. He merely protected the type of colloid that made up the drilling mud so that the salt could no longer coagulate the clay; he also brought about a type of transformation which takes place when an oil-in-water emulsion is transformed into the water-in-oil type thus introducing the idea of oil muds which is looked upon with great favour everywhere."

Bhatnagar's long years of concentration on colloids were completely justified.

As Director of the University Chemical Laboratories scores of parents used to besiege him asking for the admission of their sons for Applied Chemistry. He tried hard to persuade them that their 'brilliant sons' before going in for Applied Chemistry must be treated as 'Chemical Chemists.' "Any attempt to avoid Pure Chemistry and begin with Applied Chemistry is like erecting a fortress on foundations of sand."¹

At the same lecture, from which the foregoing remark is taken, S.S.B. said that "An investigation that has nothing but a purely scientific interest, may, and often does, yield information that is of great practical importance.... Monsieur and Madame Curie did not have the cure of cancer in mind in making their patient search for radium."

Nor, be it said, had Bhatnagar the solving of a mud problem in mind when concentrating

1. *Chemistry.. Pure and Applied*, Lecture by S.S.B. at the Indian Chemical Society, Calcutta.

upon colloids. Yet without this concentration no hope of solving the mud problem.

Pure Science = human knowledge.

Applied Science = gain, by human knowledge practically applied.

Obviously, one cannot apply human knowledge until there is human knowledge to apply. This fact Dr. Bhatnagar tried hard to instil into the minds of importunate parents whose eyes were possibly fixed more on the money value of Applied Chemistry, in the form of successful industrial products, than on the study of Applied Chemistry itself.

That there is money, and plenty of it, as an outcome of Applied Chemistry to industrial problems and to industrial products there is abundant proof.

The mud problem, for instance, solved by S. S. B. was worth so much to the firm of Messrs. Steel Brothers that in gratitude to Dr. Bhatnagar they offered him a sum of Rs. 1,50,000 for research work on any subjects of petroleum interest that he cared to choose. He preferred everything to be done through the University. So the Company gave a grant that was conveyed to the Vice-Chancellor of the Panjab University. The following is an extract from a letter from Steel Brothers to the Vice-Chancellor:

**Steel Bros.
Research
Grant.**

10th August, 1934.

Subject to certain conditions, we have agreed to place at the disposal of Professor S. S. Bhatnagar, University Professor of Chemistry of the

Panjab University, a sum of money for research work on petroleum and allied subjects which will be paid in equal instalments over a period of five years. This is being done in recognition of the ability and keen interest shown by Prof. Bhatnagar in the solution of certain problems connected with mud and oil and at the recommendation of our representatives who have seen something of the excellent equipment and type of work which is being done at the University Chemical Laboratories at Lahore.

That results of permanent interest to pure science and industry may accrue from this association is evident from the fact that our technical representatives advise us that Prof. Bhatnagar very generously wishes to place this money at the disposal of the University with a view to inaugurating a department of petroleum research under his guidance and that he has, in the interest of the University, refused offers which might have benefitted him personally to a greater extent.

We trust that this association with Prof. Bhatnagar and the University will be acceptable to you and your Senate and that it will prove beneficial to all parties."

At a meeting of the Syndicate on the 5th October, 1934 this generous offer was unanimously approved as also was the scheme outlined by Prof. Bhatnagar for six research scholarships designated by the names of Emerson, Woolner, Fazal-i-Hussain, Shadilal, Donnan and Dunnicliff.

The syndicate further unanimously decided

to record its "gratification that the excellent work done by Professor Bhatnagar in research on Petroleum had been recognised and to thank him for converting a personal offer largely to the benefit of the University and research.

At the same meeting Dr. Bhatnagar was authorized to take immediate action to start the arrangements for developing the research work as proposed.

This he promptly did with the result that important investigations were carried out on the subject of decolourization of waxes; increasing flame height of kerosine by eliminating deleterious matter that caused smoking, thereby increasing the luminosity without consuming more oil. Investigations were also made on the utilization of waste products in vegetable oil and mineral oil industries.

The year 1935 was one of intense activity in the laboratories with the result that Steel Bros. invited Bhatnagar to England, in 1936, to pursue his investigations, by inspecting their factories, both in England and abroad.

At the Convocation of 1935, Sir Herbert Emerson, Governor of the Punjab, in the course of his address referred to Petroleum research in the University laboratories in the following terms.

"In this connection, I may refer particularly to the first class work done by that very distinguished scientist, Dr. Bhatnagar, in the University Laboratories on the technology of oils. I am told by men who know the practical side of industry, that the results already attained promise

to be of great commercial value, while the possibilities are immense. We know that a well known firm has shown its faith in Dr. Bhatnagar and his assistants by a handsome financial contribution towards the cost of the work that is being done."

Meanwhile, in spite of his multifarious duties and heavy responsibility, Bhatnagar had found time to write, in collaboration with Dr. K. N. Mathur, a comprehensive compendium entitled "*Physical Principles and Applications of Magneto Chemistry*." This was published in 1935, and is recognised as a standard work on the subject, the first to be written in English. When it appeared, letters of congratulations were received from Prof. Donnan, Prof. Stoner, Lord Rutherford, Sir P. C. Ray, Sir C. V. Raman, Prof. G. N. Lewis and many others.

Sir P. C. Ray wrote :

"On turning over the pages of *Nature* my eyes chanced upon an advertisement of Macmillan's in which I find your book at last advertised. That the book is of a high standard is indicated by the most excellent review in *Current Science* by Professor Stoner, who is competent to judge. As far as I know Meghnad's is the only text book in Physical Science which has been adopted by foreign universities; and it gladdens my heart that another work in Physical Science is likely to occupy a similar place. My days are practically numbered; and my great consolation is that you, in Chemistry, are raising the reputation, abroad, of Indian workers."

Sir C. V. Raman wrote :

"I specially admire your energy and perseverance in having produced such a book in spite of your other important scientific and practical activities. Your name now stands as one of the very few Indians who have written scientific books claiming the respect and attention of senior workers in every country."

The book had excellent reviews and letters of appreciation and congratulations were received from countries far and near.

"The treatment throughout is very readable and up-to-date . . . A very valuable feature of the book, for which we are most grateful, is the classified list of 308 References."

B.W.H. The Scientific Worker.

"Professor Bhatnagar and Dr. Mathur are to be congratulated on the selection and treatment of their material and the production may be recommended to all workers in the border-lands of Physics and Chemistry, as well as the scientific public in general. For the non-mathematical reader the book is not disturbingly algebraical."

Notices Respecting New Books.

"Prof. S. S. Bhatnagar and Dr. K. N. Mathur have written the first account in English, on magnetism from the point of view of the physical chemist . . . The book is

written for the physical chemist, and is a plea for the wider use of the weapon which magnetism offers to attack chemical problems of all kinds."

L.C.J. Nature.

"The aim of this book is to place before chemists a comprehensive and at the same time comprehensible account of the experimental and theoretical researches which have been carried out in this field. The authors have been extremely successful in achieving this aim."

Edmond C. Stoner, "Current Science."

Although Bhatnagar was in great demand for addresses at the many science meetings that were being held, research work at his laboratories forged ahead. He had brought into being a devoted band of research workers and under his guidance, and also in his absence they were doing remarkable work.

The utilization of wastes was being assiduously developed and many processes were being perfected such as the process of solidifyingessian and of the making of fabric from agave.

A bewildering number of scientific publications stand to his name. He had been writing since 1920 and from the time he became Director of the University Chemical Laboratories there was much writing in collaboration with his research scholars. The name of Mata Prasad is often linked with his. He also wrote in colla-

boration with Dr. H. B. Dunncliff, N. A. Yajnik, K. G. Mathur and many others. By the time he had become Dean of University Instruction in 1937 his publications in journals or in pamphlet form equalled 100, and by 1942 they numbered 142—on every conceivable aspect of Chemistry.

His reputation in the Punjab and beyond it had soared, and his generosity, selflessness and zeal for research in founding the Steel Scholarships had stirred the feelings of many.

Two of his closest friends, Dr. M. N. Saha, F.R.S. and Dr. J. C. Ghosh¹ wrote from the fulness of their hearts. These two had stepped side by side with him in London during post-graduate days and knowing him so intimately they were able to realize the greatness of his gift. Each of them wrote congratulating him on the same day, October 10th, 1934.

“India does not lack in men earning millions,” wrote Saha, “but if a few of these millionaires were guided by the fine example of a comparatively poor teacher like yourself, her scientific and social progress would have been more rapid. None but a true researcher knows how much our energies in this country are being wasted for lack of funds—once more, in cordial admiration for your noble deed.”

“Your generosity has no parallel in India” wrote Ghosh “To make over to your *Alma mater* a sum of Rs. 1,50,000 which was the reward for your distinguished service, in

1. Now Knighted.

the field of applied research, is a unique gift—no praise can be too high: To be able to claim you as a friend has been a matter of pride—it is even more so now.”

“The event must be quite unprecedented in the history of University research in India, and reflects the greatest honour upon yourself and upon the position to which you have attained. I need scarcely tell you that as one of your old professors I feel highly pleased by the great success of my former research student, Bhatnagar.” F. G. Donnan.

On January the 1st 1936, S. S. B. received his first honour—the O.B.E. **O.B.E.** There was dissatisfaction among his friends at this rather lukewarm recognition of the sterling work that he had done in the University Laboratories and in his generous aid to research. One of them wrote telling him not to be discouraged because the real meaning was Oil Borer of the Empire, and so he could write O.B.E. after his name with justifiable pride.

The unknown writer of the following verses will, I am confident, permit their inclusion at this point.¹

1918

There was a lady of high degree
 Asked wounded soldiers out to tea,
 And said Oh yes! Ah dear me!
 And she, thank God, is an O.B.E.

1. The writer is indebted to Prof. A. V. Hill, who passed the verses onto her.

There was a man of industry
 Who made big bombs for the R.F.C.
 And pocketted all the L.S.D.
 And he, thank God, is an O.B.E.

There was a young man of 23
 Who got a job with a fat M.P.
 Not caring much for the infantry,
 And he, thank God, is an O.B.E.

I had a friend—a friend—and he
 Just held the line for you and me.
 He kept the Germans from the sea
 —and died, without the O.B.E.
 Thank God ! without the O.B.E.

As a result of the indefatigable work of Dr. Bhatnagar and his research scholars, under the Steel endowment, commercial interest to the founders had been so great that they wrote to S.S.B. saying that they wished to discuss with him a further extension of their Research Scheme.

**Extension of
 Steel Bros.
 Research
 Scheme.**

In 1936, Dr. Bhatnagar, accompanied by his wife, went to England, where he also attended the Empire Universities' Congress in Cambridge at which the presidential chair was filled by the Hon. Mr. Stanley Baldwin now Lord Baldwin, and at that time Prime Minister of the British Parliament.

The renewed contact with Steel Brothers led to lengthy discussions and to a tour of their diverse factories in Germany and Poland as well as in England. Bhatnagar solved many problems for them in their multifarious commercial undertakings, mostly concerned with food products,

cooking and salad oils. In Poland where rice was the main basis of manufacture he tackled the rice weevil and also the deterioration of breakfast foods. In Germany, the product was mainly glucose. In London where oil seeds were the basis, he got down to the discolourization and the deodourizing of oil as a food product. He also visited Hull where the main products were breakfast foods and oils.

The then Vice-Chancellor of the University of the Punjab, Dr. George Barne, Bishop of Lahore, eventually received a letter from Steel Bros., in which the research grant was increased from Rs. 1,50,000 spread over five years to Rs. 4,00,000 for the extended period.

The following extracts are from a letter dated the 4th August 1936 from Messrs. Steel Bros. and Co. Ltd., to the Vice-Chancellor of the University of the Punjab.

“As a result of Professor Bhatnagar’s visit to this country and our discussions with him in connection with the work which is being carried out under the scheme inaugurated in your University for the researching of petroleum and applied subjects, we have the pleasure of advising you that we are prepared to extend the scheme for a further period of five years from the expiry of the present arrangements. This will give the scheme ten years’ life and so enable some at least of the long and patient researches adequate time to be developed commercially and prove an incentive to the workers. The Punjab University will thus be associated

with industrial developments for a long period." Here some lines followed in which they further agreed to increase the total remuneration to the researching staff. "The actual allocation *i.e.* scale of salaries fixed for the researchers would, of course, require to be made on the recommendation of Dr. Bhatnagar and so far as individual members of the staff are concerned the provisional allocations would be contingent on their continuing to do good work.

We feel some such arrangement will serve the purpose of showing that there are prospects in the posts these researchers are filling and will provide a keen incentive to continued interest in the work they are doing. . . .

We trust that the Senate and the Syndicate will be pleased with the extension of the Research Scheme. We feel that the results of the scheme under the able direction of Prof. Bhatnagar will eventually prove not only of commercial value but also of general scientific value in the academic world. . . .

We hope the University appreciate our offer and his decision, both of which we feel sure are in the interests of chemical research under the auspices of the Lahore University."

Here is a proof, if proof need be, of the interdependance of industry and applied scientific research, which so obviously not only stimulate one another, but are indispensable one to the other.

The decision referred to above was about an attractive offer from a wealthy industrialist to S.S.B. to go to Delhi as Director of a laboratory for industrial research that he intended establishing. It was while negotiations were proceeding, that Bhatnagar had been drawn into the new contacts with Steel Brothers and as a result of the plan to extend their scheme, he decided to stay in Lahore and not accept the offer for Delhi, as Director of the research Laboratory of the wealthy industrialist. One of the conditions of the extended scheme was that the Steel Scholars should always work under Bhatnagar and that they were to accompany him in any new field of research work that he might happen to take up.

In the first agreement between Steel Bros. Dr. Bhatnagar and the University, there had been a clause about patents which "would be jointly in the name of Messrs. Steel Bros. and Company Limited and Professor Bhatnagar and, or, his chemists and any profits would be shared equally between the Company on the one hand and the parties concerned on the other."

A characteristic sequel to this clause was that Bhatnagar with his share of the profits had started a permanent Research Fund which was to be named after Sir Herbert Emerson.

Other endowments for research work in Lahore numbered five, in the names of Lala Shri Ram, Delhi; (Cloth) Messrs. J. K. Mills Ltd., Cawnpore (Cloth); Sir J. P. Srivastava, Cawnpore (Rosin-turpentine). Messrs. Ganesh Flour Mills Ltd., Lyallpur and Messrs. Tata Oil Mills Ltd., Bombay, totalling a sum of Rs. 13,900.

When the second gift from Steel Bros. was announced in the papers, resulting in the extension of the Research Scheme and Bhatnagar's refusing any personal advantage from it or from royalties on patents, the then Governor of the Province was heard to say. "This fellow seems rather fond of giving his money away." The explanation being that Bhatnagar's refusal to accept any financial reward for his research results was because of the conviction that had grown upon him, that scientific work loses its cultural value if the worker becomes money-minded by deriving financial benefits for himself. He felt that the public would doubt the sincerity of a man who works hard in order to make himself rich and that students derive inspiration only from a selfless worker.

About this time a profound change took place in the University life of **Death of Dr. A.C. Woolner** Lahore through the death of Dr. Alfred Woolner, the Vice-Chancellor. He was both Scholar and Orientalist. In his early manhood he had taken great interest in the gipsies of England. He had made a study of the Romany and of their language. He even for a time lived their life, being himself something of a gipsy in disposition. He once told the writer that it was the Romany language that had led him to Sanskrit, there being many words in common. For several years he was Principal of the Oriental College in Lahore. There was great dignity about him and delightful humour. His wife, who has recently died, was a charming hostess. They lived quietly in a pleasant bunga-

low, built in the old style and well set back from a main road. It was surrounded by a garden that was more like a park. One had the feeling of being in England—England of the old days—when with them. Dr. Woolner was an excellent Shakesperian actor. He had played the part of Bottom the Weaver at the Government College at the time that Prof. Jones had played Puck. With the Vice-Chancellorship he combined Dean of the University. He was succeeded, temporarily, by the Lord Bishop of Lahore, Dr. George Barne, as honorary V.C., while Dr. George Matthai, Professor of Zoology at the Government College, became Dean of the University. Bishop Barne was succeeded by Malcolm Lyall Darling of the I.C.S. (now K.C.I.E.), well-known as an authority on the Punjab peasant.¹ Darling maintained the cultural atmosphere of his predecessors, but neither he nor the Bishop before him could spare the time demanded of them for the Vice-Chancellorship, and in 1938, it was decided to make of the post a wholetime affair when Khan Bahadur Mian Afzal Hussain was appointed on a permanent basis.

Under Malcolm Darling's Vice-Chancellorship, Bhatnagar was Dean of University Instruction in succession to Dr. Matthai. He served for one year, until the permanent V.C., was appointed, but was retained as Dean of the Science Faculty.

In 1937 several processes were perfected and samples of products for common use littered the

1. Author of *The Punjab Peasant in Debt and Prosperity*, *Rusticus Loguitor*, *Wisdom and Waste in the Indian Village*, etc.

official table of S.S.B., solidified hessian was one of them. This opened out a vista of better housing for villagers in the hills where the heavy rainfall necessitates a roof that is more rain-proof than thatch and less expensive than of slates. It is a common sight in the hills and valleys to see the ruins of mud brick sheds and dwellings, simply due to inadequate roofing. Thatching requires constant renewal and many villagers live wretchedly during the rainy season because they had been unable to renew them. Tinkering at an old thatch often creates new leaks, even if it mends the old ones, and a small leak at the beginning of the rains becomes a big leak as the rains continue, in spite of constant tinkering, and before the rains are over, walls collapse. Grass for thatching, even if there was money to buy it, is in great demand for dry fodder. Moreover the grass that is grown on dry hill tracts is not really suitable for thatching. In the hills are no marshes for the cultivation of a reedy grass for thatch, that could withstand heavy rains and would not need to be so constantly renewed. I myself, in the Kangra Valley, for nearly twenty years have had this problem to tackle, as all my buildings are built with mud bricks and most of them are thatched. When, therefore, S.S.B. showed me his solidified hessian and said that sheets of it, corrugated, would make good and cheap roofing, I was thrilled.

Mr. Herbert Morrison, in addressing the Regional Council of the Labour Party at Leeds, on the 3rd April, 1943, declared that "an industry which consciously pursues social ends can be

invigorated thereby as much as by the spur of competition and the free market.”¹

This declaration throws a flood of light on the industrial researches of Bhatnagar.

Any one who has seen his delight in the success of even a trifling result that leads to social ends can testify to the truth of Mr. Morrison's declaration. In the solidifying of hessian, for instance, he used to carry scraps of it in his pockets in varying degrees of solidification. When meeting a sympathetic and interested friend, out would come a sample.

“Look at this. Bend it.” You could not nor could it be broken.

“Try this, and this” he would say, showing you later and later developments, until you were in triumph shown the latest.

“Some day” said he, “this will be a substitute for galvanized iron. This is the one that I shall corrugate for roofing.”

Another process completed at this time was fabric made from the fibre of agave, a spiky cactus that grows wild and is sometimes used as a hedge to obstruct cattle from wandering into the fields. The fabric had a linen-like texture, rather stiff. This led to experiments in making fabric from Ak, a cotton material which was warm, light and soft, proving to be of a great use later for war purposes.

In fact, the war came along before these products could be used for social needs, by being

1. Quoted from “Leadership in a Dynamic Society” leading Article in *Nature*, 24 July 1943.

put on the open market. Now they are supplied exclusively to the army.

In the Convocation address to the Punjab University in 1937, the late Sir Sikandar Hyat Khan, then Prime Minister, remarked, "It is gratifying that the Chemistry Laboratories, under the able and enthusiastic guidance of Dr. Bhatnagar, continue to do valuable research work which, apart from its educational value is proving of great benefit to industrial concerns in the Punjab and elsewhere. Some of the results of Dr. Bhatnagar's researches have deservedly earned for him and his associates an international place in the field of Applied Chemistry."

In the same year, the Hon'ble Rai Bahadur Chaudhri Sir Chhotu Ram, Development Minister, Punjab, at a meeting of the Indian Chamber of Commerce said, "Lastly, I may advert to the subject of research. Industrial advance depends, in a large measure, upon chemical research. I have already discussed this subject as well as the subject of a survey of our mineral resources with Dr. Bhatnagar. I assure you that work of the highest industrial importance is being done and experiments of the greatest industrial value are being conducted in the University Laboratories at Lahore, under his supervision. I do not know whether I can be more specific with regard to the nature of those experiments without his permission. But I suggest that those of you who are directly or indirectly interested in chemical research, should go to those laboratories. A visit is well worth the trouble. I feel that we have in Dr. Bhatnagar, a prototype of Dr. Sir P. C. Ray.

It gives me a personal pleasure and a peculiar sense of pride to make this claim because Dr. Bhatnagar came originally from Rohtak, my own native district."

"It's a great thing, life. I wouldn't have missed it for anything." These simple words give an index to the personality of Ernest Rutherford, "the world's greatest modern scientist."

Jubilee of
Indian Science
Congress,
Calcutta 1938

Lord Rutherford, M. O., F.R.S., was to have presided at the Indian Science Congress at Calcutta on January 3rd, 1938. His unexpected and sudden death on the 15th October, 1937, deprived India of that honour and privilege.

He had written his address two months before and it was read by Sir James Jeans in his place, who prefaced his reading by a tribute to "one of the greatest scientists of all time".

The Indian Science Association had been founded in 1913 and so the Congress of 1938 was to celebrate its Silver Jubilee. This was not the only remarkable thing about the Science Congress of 1938. An event of outstanding importance coincided — the Annual Meeting of the British Association for the Development of Science, was to be held at Calcutta, in conjunction. This was the first time it had met in India and many difficulties had to be overcome before arriving at the decision, not the least being the fact that, due to climatic conditions, the Congress had to be held in the cool months between November and February, during the British academic year. These difficulties were surmounted.

How overjoyed Rutherford would have been at this coming together on Indian soil of world scientists. One can almost hear him say "I would not have missed it for anything"—and yet he did. The words of his address, read by Sir James Jeans, had poignant significance.

In sketching out the needs of the Indian Empire in Science and Industry, he said :

"The utilization of science implies, moreover, a planned scheme of research. The experience of some of the Overseas Dominions may prove of service to India. In Canada and in Australia there are State and Provincial Governments as well as a Federal Government and in both cases it has been found expedient that the research organizations of the country should be truly national and responsible to the Federal Government alone.

Even in an Empire the size of India, whose resources and needs of various provinces are widely different, it would seem that centralized organization of research is the only way of avoiding waste of money and effort. The detailed planning of research must be in the hands of those with the necessary specialized knowledge, and they must be able to act without suspicion of political or racial influence."

At this point of his address one can imagine the reactions of Bhatnagar, who was a delegate from Lahore. In the body of Lord Rutherford's address he dwelt upon his own subject of research—the atom. In concluding, he said, "I have tried to outline the contribution to scientific knowledge made in India, and the need of the

immediate future in science is to play its part in national welfare—science, not only as a form of intellectual activity, but also as a means of furthering the progress of her peoples.”

Bhatnagar presided over the Chemistry Section of the Congress and delivered an address on *Recent Advances in Magnetism Relating to Chemistry*. In thanking the organizers for having done him the honour he said that its value was enhanced by the knowledge that he owed his elevation to this position to the self-abnegation of Acharaya Sir Profulla Chandra Ray. “It is not the first time that he has practised this kind of self-denial—his life indeed, is a long poem in self-sacrifice.

This Congress is a great occasion in the history of the Indian Science Association, not only because today we can look back on twenty-five years of proud and varied achievement, but also because we have today in our midst some of the most distinguished scientists of the world, including representatives and members of the British Association for the Advancement of Science. On your behalf and on my own I extend a most cordial welcome to them. Their presence here today proves that in the world of science there are no barriers between the East and the West, that science can transcend racial, political and economic boundaries and that scientists all the world over are a fellowship dedicated to the pursuit of truth, to the service of humanity and to the cause of good friendship.” In concluding his survey, he said “this historic meeting will help us in forging new bonds of personal magnetism

which will lead to further advances in Physics and Chemistry and to the cementing of the relations between the East and the West and the old and the new worlds."

The death of Lord Rutherford had cast its shadow on the celebrations, but India was honoured by the presence of another great scientist who had done remarkable work in Astronomy. When the Congress was over, Sir James Jeans, visited some of the universities and gave addresses which were greatly appreciated. Contact with him was a very great stimulus to the scientific world of India.

No account of the Lahore period would be complete without, at least, an indication of the psychological aspect of S.S.B. and of the reactions of his researchers to the personality of "this peculiar man," as one of them called him. This could only be told by themselves. There was a batch of five that took their doctorate under him, whose experience and knowledge of their teacher would be worth recording. I chanced to meet one of them, Dr. K. G. Mathur, and for a few fleeting minutes, he overflowed with reminiscences and anecdotes, I gathered from his talk that they looked upon S.S.B. as quite uncanny. To begin with, his range was immense. Mathur said that the beauty of research with him was that the water-tight compartments of chemistry were fused under his comprehensive grasp. All branches were covered. Doctor Saheb was ready to develop on any line and to tackle any conceivable problem: X-rays,

photography, biochemistry, magneto-chemistry, Raman effect: he was on familiar terms with them all. The variety he was capable of handling was astounding. He would jump to conclusions, in a flash, and stick to them through thick and thin, without, apparently, any findings. They frequently thought him wide of the mark but, as often as not, after much labour, found that he had been right. Intuition? Perhaps, he could not say, but there it was.¹ One day he himself had been sent for and told by Doctor Saheb to solve a paper problem that had come into the laboratory and to be quick first about it. He was to go to Saharanpur by the train next day. Mathur was aghast—he knew nothing about paper, had never even given it a thought. “That’s no matter. Here’s the problem and it has to be solved. Get down to it.” He demurred, but doctor Saheb was adamant. There was the problem and it just had to be solved. “Go on—get down to it.”

Get down to it, he did. He simply had to. There was no question about it. Mathur took some books from the library, went home and dipped into them. He passed a sleepless night and the next day went to Saharanpur. He was shown over the Mill by the Manager and casually took a book from their library, told the Manager to order in certain chemicals and went by train to his parent’s home that happened to be about thirty miles away. He studied the problem far into the night. When he had opened the Paper

1. Prof. Benode had called it *improvisations*.

Mill book, he found that most of the leaves were uncut. While he was cutting them and scanning the pages, his eye fell on the very problem he had to deal with. He got down to it and next day, with a light heart, went to the Paper Mill, worked with complete confidence and solved the problem.

On his return to Lahore he was elated and naturally wanted to tell all about it to Doctor Saheb, but he was not in the mood to listen.

"You solved it—that's the main thing. I knew you would. Now, get on with your work."

This was the turning point in the career of K.G. Mathur. Until then his researches had been in pure chemistry but this experience led him to applied research. Now he is chief chemist in the Delhi Cloth Mills. He also has come to believe, with his teacher whom he calls his *guru*, that a *good researcher always finds*.

The paper problem incident illustrates the driving power of S. S. B. His pace also was terrific. The researchers, in fact every body in the lab, had to keep pace with it.

On another occasion, Mathur and a colleague, with the help of two or three laboratory hands, were getting up an exhibit which was to demonstrate the quality of a new anti-gas fabric upon which Mathur had worked and that was considered superior to the fabric in use. The Master General of Ordnance wished to see it tested by a practical demonstration. Not long before he was expected at the lab. The 'Steel' chemist suggested that it would be better to alter the set-up

from horizontal to vertical. There was considerable discession on the point. Four days before the M.G. of Ordinance was expected, Mathur and his colleague rather reluctantly agreed to alter the set-up and for four days they laboured. It was not until the eve of the visit of the M.G. of Ordinance that they were ready to demonstrate the result. No result was forthcoming! S. S. B. left the lab. well after dark and had told them not to go on for more than one hour. After some time he rang up from his home, and found they were still at the lab. He could tell by Mathur's tone of voice that they were in despair. So he ordered his car and went to them. At that time he was living beyond the Lawrence Gardens, about two miles away. When he arrived at the lab, he told the distracted workers to go home and get to bed. He could see that in their nervy state they would only make matters worse. There was nothing to worry about, he told them. They were to meet him in the lab, in the morning at 8 a.m. and they would get down to it. After S. S. B. had gone they remained working until midnight, with no result. The next morning Doctor Saheb arrived in good time, and in their presence he manipulated the apparatus and behold it worked—it worked beautifully. The researchers were greatly impressed—another uncanny exploit of this, peculiar man.' When I reminded S. S. B. about this, he laughed and said "There was no trick at all. It was just a matter of steadiness. A very delicate adjustment had to be made. That was all"

Prof. Donnan and Bhatnagar kept in touch with one another by occasional letters. Here is an extract from one of them.

October 2, 1938.

"You deserve every happiness and good fortune, for you possess not only a fine brain and a great mind but also the kindest and sincerest of hearts. I regard you, as does also Sir James Irvine, as the outstanding man of science in India. I think you must know that you are a man of action as well as of thought. May you prosper and gain happiness in all your affairs !

I very sincerely hope that the Royal Society will take my advice and elect you soon as a Fellow. None deserves that honour better than yourself. Through your own work and the work of your collaborators, so well organised under your able and beneficial direction, you have built up a school of research that can compare with any in the world."

On the 3rd January 1939, the Indian Science Congress was held once more at Lahore and once more the heavy duty of organisation fell upon Dr. Bhatnagar, who was ably assisted by Dewan Anand Kumar, University Reader of Zoology. As before a house party of scientists, Bhatnagar's special friends, met under his hospitable roof but it was the roof of a palatial bungalow that he had had built some two miles away in spacious grounds. The dining hall had a huge inset sideboard, a capacious buttery, an electrified

**Indian
Science
Congress
Lahore, 1939.**

'hot case' and every modern gadget that the ingenuity of the architect could contrive. Here the house party had convivial fore-gatherings with Bhatnagar in gr̄eat form as genial host. The writer too was one of the guests having been summoned once more from the Kangra Valley to beautify University Hall for the banquet. Among the house party were Dr. J. C. Ghosh, Dr. J. N. Mukherjee and Dr. Krishna.

H. E. Sir Henry Craik, Governor of the Punjab, presided at the inaugural meeting of the session of the Congress at which the presidential address was delivered by Dr. J. C. Ghosh. In the opening speech His Excellency said, "There has been also a much greater output of written works, notably in Physics and Chemistry, while the Chemistry Department, under the distinguished direction of Professor Bhatnagar, has attracted students from all parts of India, and its achievements have won recognition in Europe also.

It would be presumptuous of me, educated as I was at a time when science had scarcely established its claim to be a serious subject for school study, to attempt to describe, or even to name, the particular fields of research in which Professor Bhatnagar and his assistants have obtained decisive successes; but I understand that their work is of both practical and academic importance. On the practical side, science is being applied to industry with a view to making the fullest and most profitable use of all the natural products of the Punjab, and such is felt to be the commercial value of Prof. Bhatnagar's

work that English firms have placed at his disposal large sums for the prosecution of his investigations. On the academic side the researches which have been made into the magnetic properties of atoms and molecules with the object of revealing the nature of chemical reactions are, I believe, of a fundamental character."

The presidential address of Dr. Ghosh was brilliant. It captured the minds and hearts of his hearers. Of necessity coldly scientific, it was warmly human too, with delicate touches of humour: philosophical also, and now and then it pulsated with feeling. It was, in fact, a masterpiece of oratory.

Dr. Ghosh spoke feelingly of Sir Jagdish Chandra Bose, "That voice is now stilled in death but he will always be remembered with gratitude as the great master and pioneer whose work and example have revived the spirit of scientific enquiry in India after centuries of stagnation.

Last year, the Indian Science Congress celebrated its jubilee with great pomp in the city of Calcutta, which had witnessed the birth of this Association two years after her dethronement from the proud position of the Imperial Capital. A brilliant galaxy of scientists took part in the deliberations, and for President we had elected the greatest scientist of the British Empire. The sudden death of Lord Rutherford was a cruel blow, but it was some consolation that he finished the writing of his inspiring address which was read by his brilliant successor, Sir James Jeans.

As I recall today these great names, I feel weighed down by a sense of responsibility. To follow them is perforce to follow very far behind." Then came a long dissertation on matters purely scientific

"The credit of initiating researches in physical chemistry in India goes to Professor Dhar who was called to the chair of chemistry at Allahabad in 1919. Then came in 1921, the Three Musketeers from the laboratory of Prof. F. G. Donnan—Bhatnagar, Mukerjee and Ghosh (himself) Within the precincts of this University, it is not necessary that I should have to make a special pleading that scientific knowledge and industrial activities should be co-ordinated or that our academic laboratories should not be divorced from practical affairs. We have here a flourishing Honours School of Technical Chemistry; and the genius of Professor Bhatnagar has provided a bridge of communication between scientists and industrialists. Nowhere is the beneficial effect of contact between universities and industry better exemplified than in the programme of researches on oil technology, now carried out under the supervision of Professor Bhatnagar, with the aid of funds provided by Messrs. Steel Brothers. In pre-war days, such close intimacy existed in Germany alone with the result that she rapidly outstripped her rivals in industrial enterprise. But a new epoch of industrial research in Europe and America had begun with the end of the great war. Last year in the Presidential Address of Lord Rutherford

we had a very clear exposition of the extensive activities of the Department of Scientific and Industrial Research in Great Britain. He stated with evident satisfaction that this bold experiment in the co-operative organization of research which is unique in the world, had undoubtedly proved a great success . . . Much was expected of the policy laid down by the Government of India in 1915 under stress of war. But these lessons of war were soon forgotten, and all that has been achieved is the setting up of an Industrial Research Bureau, controlling with the aid of an Advisory Committee, a small research laboratory attached to the Test House at Alipur. The report of this Bureau for 1937-38 is a miserable document compared with the corresponding report of the Imperial Council of Agricultural Research. I should not be misunderstood. I have no complaint against the personnel, but only against the step-motherly treatment meted out to industrial research in the country." Then followed a caustic and ironic passage on the problems of poverty and unemployment, of national defence and economic regeneration. "These" said Ghosh, "cannot be solved without industrialization, and as a step to such industrialization, a national planning committee should be set up which will formulate comprehensive schemes for the development of industries in India.

As an indispensable adjunct to this planning commission there should be set up an All-India Council of Scientific and Industrial Research with functions and powers similar to those en-

trusted to the Department of Scientific and Industrial Research in Great Britain. In India, however, men and things get so easily and without questioning, under official control that it would be apt to quote here the following observations of Lord Rutherford:—"In Great Britain the responsibility for planning the programme of research even when the cost is directly borne by the Government rests with research councils and committees who are not themselves State servants, but distinguished representatives of pure science and industry. It is to be hoped that if any comparable organization were set up in India, there will be a proper representation of scientific men from the Universities and also of the industries concerned. . . ."

Every intelligent man and woman has now to ponder deeply over the problem that the scientific search for truth has not assured the advance of civilization. Inventions intended to relieve toil, and to control the forces of nature which should have given to all a fuller and more satisfying life, have been perverted into forging instruments of destruction. The paradox of poverty amidst plenty mocks us in the face. In one part of the world wheat and cotton are being burnt and milk thrown into streams, while in another part half-naked people are starving. It is not difficult to get at the root of this evil. In respect of scientific knowledge and its applications to the problems of life, each generation stands on the shoulders of preceding one, but in respect of social, cultural and spiritual qualities, no comparable development is noticeable, perhaps

there has been a retrogression since the days of Asoka and Christ. Modern science has, indeed, become a menace to civilization, because we have refused to work for social justice, because the interests of individuals and communities have not been subordinated to those of the country and because considerations of patriotism and the prejudices of race, creed, and colour, have been allowed to override the wider considerations of humanity. Therein lies the tragedy of the modern world—the tragedy that we witness in the flaming cities of Spain and China, in the mountain homes of Abyssinia and in the concentrated hatred of the armed camps of Europe.”

The banquet at the end of the session, was a brilliant affair, with H. E. Sir Henry Craik, as guest of honour. Many notable persons were present. I had rather spread myself on the decorations having been told by Dr. Bhatnagar that no expense was to be spared. So instead of creating an illusory ceiling as before with festoons of leaves and suspended oranges, we did so by creating a ceiling effect of pale blue balls of light, each one almost the size of a football, with clusters of them at strategic points—one for instance, above the centre of the Governor's table and another above the central dining table in the hall, where I had planned to assemble some of the wearers of the loveliest saries as part of the scheme. For the Governor's table an immense canopy of pale blue muslin had been made, stamped with gold, and an extension of it fell behind the diners as a back-ground. Lights were full on under the canopy but only blue

lights were allowed in the body of the hall with lovely effect. No sooner, however, was dinner to be served than white lights were put on over the tables and the effect ruined. I sent for the manager and demurred but he said that bright lights were needed in the interest of swift serving for so many guests. So they were left on, but when coffee came round I sent a message to the electrician on duty to the effect of 'house lights off' as soon as the speeches began, so that the blue lights would again shed their soft radiance. I had made the message perfectly clear but the house lights did not go off and I was most unhappy at the missed effect. The lighting, however, at the Governor's table was all that it should be and as the speakers rose they were well illuminated before the gold-stamped blue of the back-ground that rather suggested a star bespangled universe—a very suitable background for scientists. Post prandial speeches also sparkled, full of fun and witty scientific quips. The Three Musketeers were more than once referred to and Dr. Ghosh, himself one of them, made the most witty speech of the evening.

The Indian Chemical Society, Lahore Branch, held its annual meeting on the 24th February, 1939, presided over by the Hon'ble Sir Douglas Young, Chief Justice of the Punjab. The presidential address was delivered by Prof. Bhatnagar.

The opening lines of his address follow :—
 " We live in a scientific age. Men of Science are numbered by thousands and they are cease-

lessly searching, analysing and experimenting, so that they may discover new truths which may enlarge and develop understanding, improve conditions of living and make the world a happier place for the human race, and yet Europe with its glorious achievements in the sciences, is in the throes of an armament race which threatens to engulf all nations in disaster. In Asia, the land of the rising sun, instead of casting roseate hues of a peaceful morn on the Eastern horizon is shedding blood in China in territorial acquisition. Greed, self-aggrandizement, self-preservation and preparation for war are still believed to be the surest guarantees for peace. Has science failed in its object? Does it promote unfair competition, unnecessary strife and an unwarranted sense of vanity and vain glory which must make it an inferior subject of study when compared with the humanities? Such are the questions which thinking people of the world are asking and they must be answered if the sciences are allowed to grow to their fullest extent.

The satisfaction that the Bachelor of Science derives by obtaining employment more easily than a graduate in Arts, can provide no consolation to a thinking mind. Employment in a pursuit which means continual preparation for war is neither elevating nor satisfactory."

In the body of his address he covered a wide range. First he attempted to answer the question that he himself had put. Has Science failed in its object? He did not fully answer it, but he did say that "the greatest triumph of scientific

education over a purely arts course of studies is that it makes men more internationally-minded." That is something, perhaps it is everything, in the light of its logical conclusions. It is not to be supposed, however, that internationalism was the object of science any more than that the cure of cancer was the object of the search for radium. Dr. Bhatnagar questioned the detachment of science from Society. "It is being increasingly felt that this civilization, which is largely the outcome of modern science needs the attention of prominent scientists, who would watch the reactions which the introduction of a new scientific invention produces on Society." His plea for the scrutiny by scientists of the reactions of their inventions on Society is irrefutable. From the ethics of Science he passed on to Industry. "One of the great weaknesses" he said, "of our political constitution is that industries are a provincial subject. In relation to scientific and technical programmes, narrow provincialism, would be disastrous. The subject is riddled with so many complications and complexities that even a whole India outlook would not produce a satisfactory solution of the problem. The limits if any will be the limits of the territories which we call by the name of the British Empire. The Empire idea does not mean that our identities have to be completely submerged or that we have ceased to be nationalists but that on certain matters we have to adopt a wider outlook so that we may develop rationally . . . A commonwealth based on a united interest in the expansion of industries should be a greater cementing force than all the pacts and

alliances of a political nature I wish to direct the attention of our politicians who have now begun to take some interest in industrial affairs to this aspect of the question. I am second to none in love for my country, but discretion in industry is in the best interests of real progress." Then on the subject of self-sufficiency in essential articles in war-time, he quoted the report of the Indian Industrial Commission that had been active between 1916 and 1918, to the effect that a new attitude had been evoked by the war in both Government and industrialist to the necessity of making India self-sufficient both industrially and for national defence, since it is impossible to rely on free importation in war time. "In this matter" said Bhatnagar, "of supreme interest to our country, we, who have had a scientific education can render useful service by organising ourselves so that we may be of real help to our country. We can also exemplify that mutual co-operation which is so essential to ourselves and the peace of the world." He went on to say that individual effort cannot accomplish much. All must unite in team work. The Department of Scientific and Industrial Research which was the outcome of experiences in war-time was established with the main idea of giving a well directed plan of action for co-operative effort." Then on the subject of Universities keeping aloof from industrial research, directing their attention only to theoretic work, S. S. B. was properly scornful. "That the proposed Department of Scientific and Industrial Research should en-

courage industrial research by grants of subsidy to industrial concerns and industrial research organizations and not to the Universities, hardly merits attention.

When this Department was founded in England its main function was to correlate and co-ordinate research activities wherever they existed and to help industry by advising as to where their problems could be best solved. That the universities were brought into the closest co-operation with industries by the Department of Scientific and Industrial Research, is abundantly clear from the fact that during the years 1919-1921 when I was at University College, London, at least two groups of industries had their research headquarters there . . . I myself was one of the earliest research scholars of the Department of Scientific and Industrial Research at University College because my work on emulsions had an industrial bearing.

I am all for the development of research associations, but the universities should not and cannot be divorced from industrial research activities. First-rate industrial research can only come from one who is a first-rate research worker. Problems of a routine character should not interest a great worker, but new uses for raw materials, new processes, new machines, and new methods of investigation require the highest intellect. Science and industry go hand in hand and any attempt to divorce them will lead to an unsatisfactory and unhappy state of affairs. Fundamental research helps industries but pro-

blems of fundamental interest are also suggested by industry."

The Presidential Address to the Lahore Branch of the Indian Chemical Society, ended on a rather wistful but humorous note.

"The sensitive mind of the scientist is deeply susceptible to kindness and even a small recognition of his work is a great incentive to further effort but honours are not what he lives for. Of belated honours he should think as did the the great novelist, Thackeray. "When I was a lad, I wanted toffee, but I hadn't a shilling. Now I'm a man, I have the shilling, but I don't want the toffee.

Both Ghosh and Bhatnagar in their addresses touched upon the destructive use of science. Bhatnagar tentatively, asking a question and suggesting that scientists should be more attentive to the reactions of scientific inventions on society. Ghosh is definite, when he says that "modern science has become a menace to civilization." In his address, after the passage that begins with a call for every intelligent man or woman to ponder deeply over the problem that the scientific search for truth has not assured the advance of civilization—he quoted the following lines from a source unknown: "It is not enough that mankind should be provided with tools of progress. It is a much bigger task to teach them how to use these tools."

Prof. A. V. Hill, Secretary of the Royal

1. This is the beginning of a digression to supplement the remarks of Ghosh and Bhatnagar. It is out of chronological order.

Society, London, who happens, at the moment (February 1944) to be in India has spoken in no uncertain terms in a broadcast from Calcutta on the 8th February 1944. What he says in relation to India is applicable to every country in the world. One cannot do better than to append a press notice, from the Vanguard, caption and all.

SCIENTISTS AS LEADERS

PROF. HILL ON DEVELOPMENT OF SCIENCE

(From our Correspondent)

Calcutta, Feb. 9.

India requires a supreme science commander, with two committees to advise him and several joint-boards under him, to plan and apply scientific research to India's development. This is the gist of Prof. A. V. Hills' broadcast talk from Calcutta last night.

This might cut across constitutional methods, Prof. Hill added. But if India was to prosper such a step was unavoidably necessary.

Referring to those critics who were of the opinion that nothing could be done unless India's political difficulties were solved, Prof. Hill asserted that the way suggested by him might prove a successful method to solve political difficulties. India's immediate necessity was to get a move on, he concluded.

The Civil & Military Gazette, of Lahore gave a longer account and another version of the

lines given above, which appear to be more or less verbatim :—

“There was no doubt that such a set-up would cut across accepted ideas of constitutional method; but they had to cut across many accepted ideas and to deal sharply with many vested interests if they were really to get a move on.”

It is obvious that if a move on in human welfare is desired, society must be dynamic and its leaders, scientists—scientists in the broadest sense of the term—rather than politicians. This idea was expressed in a leading article that appeared in *Nature*, July 24, 1943 entitled *Leadership in a Dynamic Society*.

“The great danger is in fact what Prof. Hutt¹ refers to as the frozen imagination of statesman and officialdom, which refuses to recognize that the present economic arrangements and the ideas on which they are based are antiquated and obsolete, leading to inequality, a substratum of poverty and insecurity. Under the cloak of a spurious superficial orderliness due to imposed uniformity and rigidity, our productive arrangements have become increasingly chaotic and unco-ordinated. Productive power has been withheld or exterminated in the interests of the private incomes of sets of capitalists and workers, while technical developments which cause capital values to fall are usually regarded as a threat to prosperity.”

Prof. Hutt argues cogently that security, peace and prosperity all depend on the creation

1. *Plan for Reconstruction. A Project for Victory*, by Prof. W. W. Hutt (International Library of Society and Social Reconstruction).

of a new order from which the right to restrict productions has been banished, and this belief is the foundation of the Plan for Reconstruction which he outlines in detail in his book. He would reserve for the State only those basic functions with which the very human and fallible men who form governments can be entrusted, but the planned system for directing War and Peace, under continuously tested fore-sight, of all the resources in the community, would give our democratic institutions an organised transition away from the authoritarian and monopolistic influence which have been frustrating the forces of order and co-operation."¹

In December 1939, the University Chemical
 S.B. Director Laboratories were visited by the
 S.I.R. Hon'ble Dewan Bahadur Sir A. Ramaswami Mudaliar, then the Commerce Member of the Viceroy's Executive Council. He was much impressed by all that he saw and from this time events moved rapidly. On his recommendation, the Viceroy, then Lord Linlithgow, wrote to Sir Henry Craik, the Governor of the Punjab, asking him to allow the services of Dr. Bhatnagar to be transferred to the Government of India, as Adviser in Scientific and Industrial Research. Bhatnagar had no voice in the matter—it was a viceregal command. He stipulated, however, that he should have laboratories for research and also that he should be allowed to bring with him the six Steel Research Scholars. This was agreed to and his official position was

1. End of digression.

now to be designated as Director of Scientific and Industrial Research.

Naturally, there was dismay in the University Chemical Laboratories when **S.S.B. Leaves Lahore.** it was known that Doctor Saheb was leaving them. He had become as much of an institution in Lahore as the buildings themselves. To lose him was unthinkable. In the tide of life, however, humans are swept along with the current, so the month of March found S.S.B. going from party to party given by friends, feasting him in farewell. During that month a meal or even tea in his own home was the exception. When eventually he was to leave Lahore for Delhi by the night Frontier Mail the station was crowded. Among those who came to give him a send off were Justice Bakshi Tek Chand, Raja Narendra Nath, K. B. Mian Afzal Husain, Vice-Chancellor, Dr. L. C. Jain, Prof. Ruchi Ram Sahni, Prof. G. D. Sondhi, Dewan Anand Kamar and many other notable persons. His research workers and staff were there in full force. Bhatnagar was almost smothered in flower garlands, before he stepped into his carriage and the train steamed out.



At a farewell function at Lahore.
from left : Justice Bakshi Sir Tek Chand, Sir S. S. Bhatnagar, Chief Justice Sir John Douglas Young of the Lahore High Court, Lady Bhatnagar, Mrs. Yajnik.

CHAPTER V

**Sir S. S. Bhatnagar, Kt., D.Sc., O.B.E., F.I.C.,
F.S.C.I., F.R.S.**

“ There is every reason to suppose that the war will give an immense fillip to Indian Industry. There will be a double stimulus. The great demand for industrial products created by the war will be a direct incentive to existing industries, while the difficulty of obtaining many of the articles we imported before will stimulate the search for substitutes or for ways and means of producing them here. We are thus presented with an unrivalled opportunity of increasing India's industrial activity. And in order to promote and co-ordinate expansion and to facilitate the exploration of fresh fields of development the Central Government have just set up a Board of Scientific and Industrial Research on which a number of distinguished scientists and industrialists of this country have consented to serve. I believe that the establishment of this new organisation will prove to be an important landmark in the history of India's industrial development, and I am sure that everybody here would agree with me in congratulating the Central Government on having secured the

services of Dr. Bhatnagar as a member of the Board and as Director of Scientific and Industrial Research. As Chancellor of our provincial University, of which he was so distinguished an ornament, I deeply regret his transfer to another sphere. But that sphere is of such enormous importance to the country as a whole, that I did not feel I could object when the request was made for his services."

These words were spoken by H. E. Sir Henry Craik, Governor of the Punjab, at the annual lunch of the Northern India Chamber of Commerce, Lahore, on the 13th April 1940.

So far, Bhatnagar's applied research had been **Research for War Interests.** mainly in the interest of industry for social ends now it was to be mainly in the interest of war. His concentration at the Lahore laboratories in the utilization of wastes and of indigenous raw materials stood him in very good stead in his new sphere of work. Solidified hessian had many developments. The substitute for iron roofing that had been intended for rural use was now to be used exclusively by the army in its demand for extensive temporary quarters for troops and air forces. It is obvious that war demand and the shortage of essential products through dwindled imports have given a tremendous impetus to industry and to the search for raw materials—an impetus that must not be allowed to slow down under post-war conditions. The Board of Scientific and Industrial Research that was set up under the exactions of war is bound to continue its activities under the exactions of peace, with, it is to be hoped,

scientists in command to work out the strategies of peace and to see that they are carried out in the campaign for human welfare in all its facets.

When Bhatnagar arrived in Delhi he was faced with the big task of bringing into being the physical requirements for scientific and industrial research. His primary need was the laboratory he had stipulated for. There was none in Delhi to suit his purpose. The Board decided therefore that, to begin with, his headquarters should be in Calcutta, where he could use the small laboratory in the Government Test House. The Indian Research Bureau had been suspended on the same day that Dr. Bhatnagar had been appointed Director of Scientific and Industrial Research. On the appointment of S. S. B. as Director of Scientific and Industrial Research the staff of the Industrial Research Bureau was made over to the new Department that had its first office in the palace of H. H. the Nizam of Hyderabad, situated near India Gate, the approach to New Delhi. Bhatnagar followed the Government of India to Simla where he remained until he took up his headquarters in Calcutta. During his stay in Simla, his work consisted in the co-ordination of scientific and industrial research, with a special bearing on the war effort, in the development of war industries.

On the 20th June, Dr. Bhatnagar went to Calcutta accompanied by his family. In August the Steel Researchers left their spacious and commodious laboratories in Lahore and came to Calcutta to

work in the small laboratory of the Test House. They soon got down to their work and produced results. Already they had completed a process of anti-gas fabric for gas masks and now they made a seaming varnish to make the stitched seams of the mask impervious to gas. They made a glass substitute for window light, as glass imports from America were blocked. The substitute also had significance as a war product, since, being based on wire mesh with translucent air-impervious coating, it did not splinter by explosive contact, thus the dangers of splintered glass under gun fire or air raid were avoided. They had been dependant on America for material for the coating solution and this too came to an end. So they experimented with indigenous material and succeeded. Then came a shortage of wire mesh and they were balked until they hit upon the treatment of a fabric that transmitted from 45 to 90 per cent light. Thus basic fabric with a certain coating became translucent, weather proof and water proof. They sold the patent to the Simbhaoli Sugar Mills and it was produced by the Indian Glass Substitute Co., at Simbhaoli, under the proprietorship of the Sugar Mills people. They started off with the manufacture of three million square feet. Steel researchers made a substitute for chinawood oil by dehydrating castor oil. Also they made a petroleum preservative for timber; and for bronze bearings, a special lubricating oil that was tested by the North Western Railway. Steel Bros. gave the N. W. Railway the formula free. These items are indicative of the work that was

going on in Calcutta under Dr. Bhatnagar's supervision. It was not long before they got up speed in their work. Bhatnagar's position now meant a lot of travelling to every part of India, inspecting advising and co-ordinating. Also he gave addresses and wrote much to elucidate the idea of the co-operative plan for scientific and industrial research, in both raw materials and products, primarily with a bearing on the war need, but fundamentally, establishing for India "a rightful place in world industry from which it will be impossible for her to be displaced after the war."

Bhatnagar was to make Calcutta his headquarters for eight months of the year and Delhi for four. But wherever he was, touring continued, and while at Delhi he went monthly to Calcutta to inspect the Steel Researchers. Under the Scientific and Industrial Research scheme certain universities received financial aid. Formerly they had been inactive in particular research work for lack of funds, but now many academic centres were stimulated and notably those which, due to Bhatnagar's dynamic contact, were already in research mood. The Hindu University at Benares and the University of the Punjab were eager to co-operate with the new Department as soon as they were enabled to do so by financial aid. India's crying need being industrialisation there was no need to beat up interest. All that was needed was funds and a right lead. These are now available and the post-war prospect for India industrially is decidedly good. The self-containment that has been imposed upon India,

not only by decreased imports but also exports, is for the war period only. The idea of self-containment is foreign to the industrial policy of clear thinking in India. No narrowly provincial, national or racial prejudices are to be allowed to queer the pitch of a scheme that aims at reciprocation, within at the very least, the British Commonwealth of Nations. Industrialism like 'charity', begins at home, but it continues within an ever widening radius. The dwindling of India's exports has resulted in a glut of raw material of one kind and another. Groundnuts, for instance, and oil seeds. The former has increased the output of a cooking essential that goes by the rather unpleasant name of margarine —*nut butter* would be better.

"With the advent of war, all exports to Germany, France and Russia have been stopped, and the oil seed market is experiencing a slump of the worst kind. The Board of Scientific and Industrial Research has addressed itself to the problem of finding uses for these products. As a result of research it has been found that experiments with vegetable oils has reacted favourably on lubricants.

The first lesson of the war which must be remembered, however bitter and unpleasant it may be, is that there is no future for small isolated states in political affairs. This truth of political and social affairs applies equally to world progress in industrial activities. There is

no future for a small nation wanting to be fully self-sufficient as an industrial unit.

The rapid progress which science is making, the tremendous speed at which distances are being annihilated, the new uses for raw materials which are being developed and the narrow and exclusive nationalistic plans of industrial expansion which Germany, Italy and Japan have set before themselves make it imperative for us to ponder more deeply ~~on~~ our industrial programme.

I fail to see how England or any of the Dominions or Colonies can treat us with indifference if we become deliberately an important link in the chain of industrial unification and expansion of federated peoples.

The needs of the Empire are vast and varied and I have no doubt that a plan could be adopted which would lead to a harmonious programme of Empire development in which clashes, resistances, obstacles and competitions could be reduced to a minimum. If it is accepted that no small colony or nation in the British Empire can develop all the industries vital for its maintenance as a civilized unit, then it is obvious that the needs of this unit will have to be met by a well thought-out plan of co-ordinated effort. In this co-ordination, basic industries such as the manufacture of cheap power, sulphuric acid, caustic soda and ammonia will have to be developed by all. Some of these industries are like basic primary education, which must be compulsory for all. The degree of specialization in industry will be determined according to the specific fea-

tures and facilities available; for example—the special genius of the people, the arts and crafts of the particular Dominions, the available raw materials, the nearness of markets, marketing facilities, climate and geographical position. It is, of course, expected that this planning will admit of flexibility and adaptability to changes in conditions which develop when peace follows war or *vice versa*. This is necessary, otherwise territories equipped for peace-time prosperity will find themselves unable to defend themselves if isolated during the war, and will collapse industrially when the war is over if they are equipped only to meet war-time emergencies.

Industry's ability to adapt itself to the changing circumstances of a country is helped most by research and technical skill. It is evident, therefore, that co-ordination in research activities is as important a function of industry as an amiable and satisfactory formula for national planning."

This long selection, from Dr. Bhatnagar's contribution to the Eastern Group Conference, leaves us in no doubt as to what the Board of Scientific and Industrial Research stands for. A wartime necessity, it will be the mother of peace-time invention that is in honour bound to serve the needs of a united India and a united Commonwealth of Nations—in, let us devoutly hope, a united world.

On January 1st, 1941, Shanti Swarup Bhatnagar received the well merited
Knighthood honour of a knighthood. In a speech delivered by Sir Henry Craik, Governor

of the Punjab, at the special convocation of the Punjab University on 23rd January 1941, he said:—

“Sir Shanti Swarup Bhatnagar joined the University as Director of its Chemical Laboratories in 1924 and has earned an international reputation by his valuable research work in various branches of science, work which has contributed substantially to the industrial development of the Punjab. His services have now, at the special request of His Excellency the Governor-General, been placed at the disposal of the Central Government for work in direct connection with the war. Deeply as I regret his temporary absence from the Punjab, I felt the request for his help was one which we could not refuse. But we all hope that he will return in due course to his appointed place among us.”

At the Indian Science Congress at Benares, held on the 3rd January 1941 Sir Ardeshir Dalal had given an account of how scientific research had helped the Tata's in building up their great organization of the Tata Iron and Steel Works. In his presidential address at the National Academy of Sciences in February 1941 Sir Shanti Swarup Bhatnagar referred to this address and commended a study of it to those of his hearers who had not been present at Benares. “Pioneers,” he said “are born and not made and just as in politics and religion the tides take a sudden turn when a leader or a saint makes his

Address at
National
Academy of
Sciences 1941.

appearance, so in industry a rapid fillip is given by the birth of a genius. The late Mr. J. N. Tata whose munificence and industrial acumen are now universally recognised, gave a tremendous turn in favour of the tide of the industrialisation of this country. He faced and successfully overcame thousands of obstacles in his way and eventually brought into being some of the most successful and important industries of India and the House of Tatas is continuing and, it is hoped, will continue to help the development of India industrially. It is reported that when Mr. Tata was putting forward his bold efforts to establish a steel and iron industry in this country, even the European experts of Sheffield and other industrial centres presented all sorts of difficulties. Alternatively the coal and iron ores found in India were considered unsatisfactory and finally when the American experts were fully convinced of the possibilities of Indian raw materials, the interesting argument was advanced that it was impossible to have a modern metallurgical industry which requires the use of furnaces working at high temperatures in the torrid climate of tropical India. It was freely mentioned that Indian labour could not stand the high range of temperature of a steel furnace and in the sacred name of the labourers' health, efforts to promote the steel industry in India were discouraged. The perseverance and persistence of the Tatas and their determination to have this key industry in India at all costs, has resulted in the coming into being of the Tata Iron and Steel Works which are now the biggest single steel

enterprise in the British Empire and are helping to develop Indian industries not only round about Jamshedpur but in the rest of India and are contributing much to the successful inauguration of modern civilisation and comforts in India. They have recently put up magnificent laboratories for metallurgical testing and research which are second to none in the Empire and which we hope, in collaboration with the Board of Scientific and Industrial Research will help in the creation of other industries such as the manufacture of ferrous and non-ferrous alloys which are a fitting adjunct to a successful steel industry. It is a pleasing feature of the Tata enterprises that they are alive to the need and usefulness of scientific research.

The new chemical enterprise inaugurated by the Tatas in Mithapur will, it is claimed, result in the appointment of hundreds of chemists and it is no wonder that the research workers in Chemistry in this country are looking forward with eagerness to these new developments."

Sir Shanti then referred to the Textile Industry commonly known as the Indian Cloth Mill Industry. "There are 389 mills in India with about ten million spindles and over two hundred thousand looms. While it is true that Bombay Presidency takes the lead in this industry and over sixty per cent of the spindles and seventy per cent of the looms are located in that province, it must be mentioned that Delhi has contributed considerably to the success of this industry. The Delhi Cloth and General Mills Limited, are under the distinguished guidance of

Sir Shri Ram and the Birla Cotton Mills—names to conjure with. In the textile industry scientific talent is required to fill up positions such as those of engineers, weaving and spinning masters, dye and bleach-house chemists and minor assistants. Research, so far, has not played a great part in the Indian Cotton Mills Industry. This industry, however, has chances of phenomenal development if scientific research is allowed to come to its aid. The range of its activities is already large and it is now capable of producing any coloured or printed cotton fabric and it touches upon some of the most important scientific investigations which are engaging the attention of workers all the world over. Allied to it and, in my opinion, capable of being developed as a sister industry is the rayon industry. If the value of research had been appreciated in this industry earlier, we should have had not only the cellulose industry with its accompaniments such as mechanical pulp industry, but also a substantial dye-stuff industry and a variety of subsidiary industries dealing with the production of sizing materials, resins, wetting agents and chemicals and a host of other auxiliary industries, such as the manufacture of bobbins, shuttles, pickers, fibre baskets, lakes and mordants.

The rapid development of the cloth industry and the keen competition which is foreshadowed make it imperative that the attention of its promoters be drawn to the need of scientific research in an organised manner. The value of such research has been abundantly proved by the

results already achieved by the Cotton Technological Institute at Matunga. Achievement in the chemical field in relation to this industry is beyond the comprehension of the layman, but is so vast that its development may revolutionise the whole industrial outlook in this country.

I am an ardent advocate of Indian Industry, not because I have any false ideas of patriotism or a narrow outlook on nationalism. Nothing will promote internationalism more than a right conception of the role of industrial development in world progress. India has been chosen by nature to be the industrial nursery of the world. With a wide range of climate, from the rice, spices and rubber-growing tracts of land of the far south, to the fruits and coniferous forests of the Punjab, Kashmir and the Himalayas in general, India is in the position of being able to offer to the world the widest possible selection of products which any soil can grow. To those may be added the mineral wealth of India which include coal, iron, petroleum; building material such as stone, brick, cement and lime; also road metals, clay, gold, manganese, mica, bauxite, graphite, illuminite, monozite, chronite, kyanite, mangasite and gypsum. The sources of cheap fuel and power are in abundance and would help in keeping down costs of production and in rendering it possible for us to have large scale industries of many kinds.

Cheap and efficient labour is available and also it is adaptable to changing industrial conditions. Apart from political factors, it is neglect

of applied sciences and lack of our ability to organize which have stood in our way and delayed the march of progress in the industrial field. It will be a blot on us, and a spurning of the offer of the bounties of Nature, if we do not harness all our natural advantages for the industrial development of our country."

Sir Shanti then drew attention to the sugar industry, which if it was to live must find uses for its by-products. Bagasse and molasses should be made to yield more income. Molasses, for example, could be put to excellent use by its conversion into food on the yeast basis. By suitable combination of vegetable, oilseed, proteins and molasses, it is possible to obtain yeast food containing easily assimilable proteins and vitamins so urgently required for a population which cannot afford meat or will not take animal proteins owing to religious or social prejudices. Professor Wilstatter made an extensive study of the subject and such foods are now being commonly used in Germany. It would not be suprising if after the war Germany admits her ability to have continued the war without meat foods owing to these developments. The introduction of a new food for the masses of India is not an easy proposition, but these products could be mixed with flour and as they are vegetarian and of good taste, it may be possible to introduce them gradually with great advantage to the poorer classes for whom suitable nutrition is an urgent necessity. Other uses for molasses were touched upon. Such as in the production of acetone by biochemical fermentation. Also, "biochemical

research made it possible to convert molasses and starches into useful hydrocarbons and into alcohols and ketones. Both molasses and starch are available cheaply in this country and it would be interesting to produce these materials for mixing with fuel oils." In concluding his address Sir Shanti spoke gracefully of the mathematicians and the theoretical physicists present who could have so little use for what he had said.

"Mathematics," he declared, "had enabled science to be systematised and the precision of a scientific measurement is not confined to its expression in mathematical units. Precision in science has its origin in mathematics. . . . A combination of physics, chemistry and mathematics forms a really good basis for the education of one who wishes to take up scientific research as a career, and mathematics is by no means the least important. It is in my opinion the most useful."

Bhatnagar's addresses continued at many meetings, expounding the aims of the Board of Scientific and Industrial Research. Also he stirred up the India Science News Association to good publicity of the venture to educate public opinion and to interest the common man. "The great inventions of science that touch daily life should be written about in an interesting manner from the scientific point of view—such inventions as the radio, telephone, telegraph and so on, This would arouse more popular interest in science than any technical disquisition.

The Association had a double task in mobi-

lizing an army of scientific men and in educating the public in things scientific. Of the two the former task was the easier. In this period of stress created by the war, scientific men have an important part to play. It will have to be more and more the concern of universities to turn out trained experts. Let us hope that science will not miss the opportunity and that we shall prove equal to the great task imposed upon us."

S. S. B. had been almost jerked out of his laboratories in Lahore, which had in a very real sense been home to him, his spiritual home. He had created a remarkable and vigorous school of research of vital significance. His researchers were to him as a family. The laboratory had been a nursery of researchers, working for social ends. Now all was changed, but he very soon adapted himself to new conditions without looking back and became immersed in his new task of concentrating upon the needs created by war, knowing full well that this concentration opened out new vistas in pure industry—after the war.

At a lecture given to the Indian Chemical Society, at Calcutta in 1941, Bhatnagar took as his subject *Chemistry—Pure and Applied*. He might have chosen as his subject *Chemistry and War Effort* or he might have spoken on a magnetic or a colloidal subject since these had been his special study for so many years. "In choosing this subject for my address, I have been guided by the consideration that many amongst my listners this evening will be University teachers and students, and they will naturally

Chemistry
Pure and
Applied

like to hear from one, who has been temporarily removed from the calm and quiet surroundings of learning to the clamorous and noisy atmosphere of industrial competition and political strife, the new impressions he may have formed of chemists and chemistry in general in relation to the rapid developments which are taking place in the country.

As University Professor at Lahore, my main contacts were with those interested in the teaching of chemistry, although I occasionally lapsed into excursions in the field of applied chemistry with good results.

Since my association with Industry and some of the rapidly advancing departments of Industrial Chemistry in India, I have come in closer contact with a large number of non-descript men of our profession for whom I have acquired a great admiration and regard. I remember the days when we used to consider greasy, fatty, oily, cement, leather, textile, coal-tar, bitumen, paint and varnish chemists as something far removed from the realm of real chemistry, to be looked down upon by the Pandits of Chemistry who arrogated to themselves the self-styled title of pure chemist almost implying that all others not of this kind were impure. In this age even the pure chemist must soil his hands, although the spoils of academic reputation may still be the privilege of the arm-chair mathematical physicist or the speculative pure scientist who does not even handle a test-tube."

At this point, I am irresistably reminded of Renan's cryptic remark in his incomparable book

La Vie de Jesu, to the effect that by leaving the serenity of the village of Nazareth to preach to the multitude, Jesus was "less pleasing to God but more useful to man." In the light of this profound saying, a scientist in Divinity, i.e., a modern truth-seeking D. D., might speak on *Religion—Pure and Applied*; or, a true Master of Arts, on *Art—Pure and Applied*, taking with justification Sir Shanti's line of argument.

In January 1942 the Headquarters of the **D.S.I.R. Headquarters, Delhi** D.S.I.R. was moved to Delhi. A new block of buildings that had been erected for Delhi University was given to the Director for research laboratories. The University of Delhi has inherited Old Viceregal Lodge in its spacious well laid-out grounds and has, therefore, a dignity that is denied to many universities in this country that are much older. Also, it has the immense advantage, as a seat of learning, of being well removed from the populous city of Old Delhi. It is further still from New Delhi. The irony of it is that the province of Delhi is exceedingly small, very few students, therefore, can take advantage of the ideal situation of its University, so pleasantly far from the "madding crowd." Here is the ideal situation for a University Town. Who knows but that, when India has come into her own, a Federal University will be established here.

The present province of Delhi was at one time part of the Punjab. It was made into a separate miniature province in 1912, when the capital of India was transferred from Calcutta to

Delhi. Its extent is about a ten-mile radius from Delhi proper.

The University of Delhi was founded on the 1st May 1922, Sir Hari Singh Gour being its first Vice-Chancellor, at which time the three colleges of Delhi—St. Stephens, the Hindu and Ramjas were affiliated to the University of the Punjab. At a later date the Anglo-Arabic and the Commercial College became constituent colleges of the University, as also did the Indraprastha College for Women. For some time after the University had been founded, it hibernated; but the present Vice-Chancellor¹ has put new life into it. Upto that time it had no professors; this year it will have six. It had no proper laboratories and no honours courses in Science; now it has both. A Professor of Law is shortly to be appointed to take in hand the reorganisation of the Law Faculty. The University Library and the Law Library have been reorganised and re-equipped. The University itself teaches Science and Law—all Arts subjects being the responsibility of the colleges. St. Stephens College, already housed in a new building on the University site, has been greatly admired and the other colleges, except Indraprastha, will migrate to the University precincts as soon as circumstances permit. For post-graduate students there is a University Lodging House—really a college in miniature—in course of construction. It is good to observe all these signs of activity going on, even in time of war.

1. Sir Maurice Gwyer.

So the Scientific and Industrial Researchers and their Director have good neighbours and they are fortunate in being actually in the University grounds, a happy omen for the proposed blend of 'pure' and 'applied' science in the University—a wish dear to the heart of S.S.B.

On the 13th September 1943 in a Radio Talk *Scientists at Work* from Delhi entitled *Scientists at Work* Sir Shanti Swarup was able to give a very good account of the results of scientific and Industrial research since April, 1940, a little more than three years work.

"It is not only in this war," he began, "but also in all wars that the need of resourcefulness as well as resources has been stressed. He went on to speak of the relative merits of these two—resources and resourcefulness. In the Mahabharata the vast resources of the Kauravas including those granted by Lord Krishna were exhausted one by one, whereas the triumph of the Pandavas came largely through the resourcefulness of Lord Krishna. At the beginning of the present war the allies had three quarters of the iron and steel production capacity of the world in their hands, two-thirds of the aluminium, nearly a hundred per cent of tin, rubber and petroleum and more than ninety per cent of copper. As the war progressed, some of these resources were lost and our leaders began to realise that they must reinforce and replace their resources with researches, that like Germany, they must mobilise their technical resourcefulness and make the strategic raw materials go much further than they would

ordinarily go. It has been established beyond doubt that in this great conflagration any power that does not harness the results of the laboratory to industrial and engineering enterprises of the country will waste untold power in men and money, without successfully aiding the war effort."

During the period of little more than three years, since the Board of Scientific and Industrial Research had been founded, among the many fields of investigations in which the researchers had been engaged were those of metals, plastics from natural sources, chemicals, drugs, substitutes for shortages, vegetable oils and other fats and waxes. "Industrial, agricultural, and other wastes have been shown to be capable of commercial utilization and salvage operations in some cases have been encouraged by our findings."

It has been estimated that goods to the value of more than four and a half crores of rupees have already been supplied as a result of the new processes and products that have been developed on the results of research work initiated by the Board. These figures do not include many production figures which are not yet available, nor do they include such items as sulphur, anti-mosquito cream, etc., in dealing with which the Board has played the role of a catalyst.

Amongst the most important substitutes that had been established by the laboratory were firstly, synthetic plastic material substituted by natural products.

- (a) Shellac.
- (b) Modifications of lac for anti-gas varnishes.
- (c) Modified lac for seaming varnishes.
- (d) Oil plastics.
- (e) Plastics from coffee beans.
- (f) Plastics from seed cakes.
- (g) Resins from other indigeneous plants.

Secondly, substitutes for paraflow, cork, window glass, white lead and zinc oxide, for good wood, for galvanized sheeting, for usual plasticisers, for enamels, for tung oil, for fibre products, for cellophane type of wrapping papers, for kerosene as illuminant and also substitutes for rubber. Some of these substitutes are now in large scale use.

The Council publishes a quarterly journal, soon to become a monthly and a Dictionary of Raw Materials was being compiled, dealing fully with the extent, scope and availability of all raw materials in the country. There have been announcements of financial help from Industry. Messrs. Tata & Sons have made a munificent grant of Rs. 8,30,000 for the construction and equipment of a National Chemical Laboratory under the Council of Scientific and Industrial Research. Also the Indian Wire and Steel Products Ltd., have donated a sum of Rs. 1,00,000 for carrying out such work as may be agreed upon between the donors and the Council.

The foregoing amply demonstrates the practical value of scientific research, the resourcefulness of which is a great contribution to the war effort.

“In commemoration of his life-long activities as a Research Worker in the realm of Pure and Applied Chemistry which branches of Science he has enriched by his Pioneer Work the Honorary Membership of the Society of Chemical Industry was conferred upon Sir Shanti Swarup Bhatnagar by the President Dr. William Cullen on January 4th, 1943, by the order of the Council and in the presence of a large gathering of Members.”

This rare distinction was conferred in London in the absence of the recipient. He has since been elected Vice-President of the Society.

Yet another honour was in store for him.

On March 18, 1943, Sir Shanti Swarup Bhatnagar received the much coveted honour of being elected Fellow of the Royal Society. His friends were overjoyed and not least his old teacher at University College, London—Prof. F. G. Donnan.

“All luck and happiness to the new F.R.S. So far as I know, you are the first Indian Chemist to be elected. Needless to say, I am very proud that this honour and a well deserved one, comes to my old friend and former research student, S.S.B.! ‘They’ must now proceed to make you a K.C.S.I. However, I know what a modest man you are, and that you value the F.R.S. above other honours, for it is no mere ‘official’ honour, but signifies a man who has distinguished himself ‘by the advancement of

Natural Knowledge'—as you have done. I can assure you that your election to the Royal Society has given me more pleasure and happiness than anything that has happened for years. I hope you will be granted many happy and successful years in which to enjoy the distinguished position in the great world of Science which you have won for yourself by your devoted labours in the pursuit of new knowledge.

Sooner or later, a new Fellow has to appear at a meeting of the Society and sign the famous Charter Book. This is the actual original book, first signed by King Charles II in 1662. I hope that great occasion will come sooner than later. Whenever it occurs, there will be great rejoicing amongst your friends in England and I hope I shall be there.

Meantime, I can imagine your many friends in India making a gala occasion in your honour. There I shall be present in spirit. I wish I could on that occasion 'materialize,' descend from the air and crown your brow with a laurel wreath! At any rate you can imagine me there, so that I shall be present in your mind, and therefore present in an honoured position.

My sisters join me in sending you and Lady Bhatnagar our kindest regards and warmest wishes.

Ever your old friend.

F. G. Donnan.'

“The election of Sir Shanti Swarup Bhatnagar to the fellowship of the Royal Society is a well-deserved recognition of his distinguished contributions to the advancement of Science. The event is indeed a signal one, for he is the first Indian Chemist to receive this high honour.

It is no exaggeration to say that a component and very important part of the great work which India is doing in the War is due to the successful labours of the Board and Council of Scientific and Industrial Research and it is a source of deep satisfaction that the Board's first director of research is an eminent Indian man of science and a Fellow of the Royal Society of London.”

Nature, March 27, 1943.

CHAPTER VI

S. S. Bhanagar, F. R. S.

Comparatively few persons outside scientific circles know what the Royal Society stands for, nor why it is so named. King Charles II in 1662 sealed the Charter of Incorporation which he granted to *The Royal Society of London for Improving Natural Knowledge*. He had taken strong personal interest in the movement that had led to the formation of this Society. In letters written by Boyle in 1646 and 1647 he refers to an "Invisible College" which it is said was identical with a gathering of men of science who from 1645 held weekly meetings of "divers worthy persons inquisitive into natural philosophy and other parts of human learning, and particularly of what hath been called *The New Philosophy or Experimental Philosophy*."

So *The Royal Society* is an abbreviation and was so named because King Charles II took a personal interest in it. That the Society is of very great importance in the world of science and that to be elected a Fellow thereof is an honour of the highest degree, is common knowledge.

"The Royal Society of London¹ is the oldest and most exclusive scientific society in Great Britain and one of the oldest in Europe. Its Council met for the first time on 13 May 1663. Newton was elected Fellow of the R. S. in 1671 and in 1708 became President, an office which he held until his death in 1727.

From 1780 onwards, admission to the Society was limited to men of exceptional distinction, and since 1847 the numbers of candidates annually recommended for election by the Council has been limited to fifteen, though quite recently this has been increased to seventeen. Concurrently, however, with the gradual restriction of the Society's numbers was the establishment one after another, of other scientific bodies. The founding of *The Linnean Society* in 1788 under the auspices of several Fellows of *The Royal Society* was the first instance of the establishment of a distinct scientific association under Royal Charter. *The Geological Society* followed in 1807 and *The Royal Astronomical Society* in 1820. *The Royal Geographical Society* followed in 1830 and *The Chemical Society* in 1841. During the last hundred years numerous other societies have been established.

University distinctions, no matter how high, are no sure passport to Fellowship of *The Royal Society*. A would-be Fellow has no chance of election unless he has done "original work and

1. This passage is taken from *The Endless Quest—300 years of Science* by F. W. Westaway. Pub. 1943; Blackie & Sons Ltd., London.

plenty of it"—work which will be readily recognized by the Society as a very serious and substantial contribution to some branch of science. The Fellowship is universally recognized as a hall-mark of great distinction."

The wish of Prof. Donnan to be present when S. S. B. signed the famous Charter Book was unrealized for the ceremony was destined not to take place in England. Prof. A. V. Hill, Secretary to The Royal Society, came to India in November 1943 to advise the Government on the organization of scientific research in this country, and he brought with him a parchment upon which he was empowered on behalf of the President of the Society, Sir Henry Dale, to take the signatures of the two newly elected Indian Fellows, Sir S. S. Bhatnagar and Prof. H. J. Bhabha, admitting them formally to *The Royal Society*.

Prof. L. P. Pavlov, the great Russian Physiologist, just before his death in 1936, at the age of 84, wrote a Bequest to the young scientists of Russia. This Bequest Prof. Hill brought with him for distribution at the inaugural Meeting of the Indian Science Congress accompanied by an Open Letter to the members thereof. In this Letter he writes: "It applies equally to all of us, old and young alike. I thought that Members of the Indian Science Congress might be glad to have a copy of Pavlov's words, so simple, so wise and so eloquent of the true spirit of scientific inquiry."

INDIAN SCIENCE CONGRESS—

Thirty-first Annual Session

Delhi—1944

*Address of Welcome by Sir Maurice Gwyer,
Vice Chancellor, Delhi University, at the
Inaugural Session of the Indian Science
Congress Delhi, on the 3rd January,
1944.*

“Your Excellency, Mr. President, Professor Hill, Ladies and Gentlemen.

This is indeed an auspicious day for the University of Delhi. We welcome first our long-lost Chancellor whom we have not seen for over twelve years; and we welcome also the Indian Science Congress, that notable association of Indian Scientists, who are meeting for the first time in the capital city of India. We welcome too, a body of most distinguished strangers, who are here to testify to that unity of science which transcends all national and racial barriers and especially among them Professor Hill, Fellow and Secretary of the Royal Society, and Member of the House of Commons, who is in a few moments by a kind of magic to transform this hall into the Council Chamber of the Royal Society itself and to admit to that august body with the traditional ceremony appropriate to the occasion those Indian Scientists whom the Royal Society has honoured, as it has honoured itself, by enrolling among its Fellows.

The University of Delhi is among the younger of Indian Universities and it is only recently that it has begun to organize and develop on progressive lines its science school and its science teaching. The presence here today of His Excellency the Chancellor and of this great body of scientists will be to the University both an encouragement and an inspiration in the tasks which it has undertaken. And I cannot but think it of happy augury that the University, not having yet a hall of its own large enough for such proceedings as this, it is the oldest Arts College of the University, which is so hospitably receiving us.¹ The conflict which was once supposed to exist between science and humanism is for all wise men at an end; and indeed if the aim of both is, as it must be, the spread of learning and the establishment of truth, it is strange that there should ever have been any question of rivalry between them. Each learns something from the other, each makes the other more fruitful, and from this happy union may a new generation arise, reflecting the beauty and vigour of both its parents.

Indian science has already achieved a position second to none in the world, and Indian men of Science have it in their power to make a contribution to the future welfare of India almost beyond human computation. They can transform the face of India, they can multiply its wealth, they can solve the problems of ignorance and poverty; and who knows whether they may

1. St. Stephens College.

not even be able to solve the most intractable of all-India's constitutional problems? It is the earnest prayer of all who have the happiness and welfare of this country at heart that all these problems surveyed, in the calm and serene atmosphere of science by men consecrated to the search for truth and nothing but the truth, with minds free from prejudice or bias, may find a solution, or at least the beginnings of a solution, at the meetings this week in Delhi.

By the irony of circumstances, war, that great enemy of human progress, affords the most powerful stimulus to scientific research that we know; but good can come out of evil, as war is followed by peace; and that part of the world which still loves peace and still believes in human personality, in the dignity of man and in honest dealing between nation and nation, will benefit hereafter from the labours of scientists to put new and ever more potent weapons in its hands to defeat the enemies of mankind. For those and for the many other blessings which men of science have bestowed upon us, we tender them our gratitude; and we hope that their labour this week and the discussions and contacts which a gathering like this makes possible will bear fruit a hundred-fold.

It is, Sir, very fitting that you should be here today to open this Congress. Yourself the grandson and great grandson of distinguished scientists, you have after leading victorious armies returned to India, determined to prove, as all your public utterances show, that science has

victories no less renowned than war. In this great task you will, I know, receive the help and co-operation of every scientist in India ; and I believe that they in their turn may look with confidence to your Excellency for guidance and encouragement. Science knows no politics, and here all are labourers in a common field.

Sir, on behalf of the Reception Committee of the University of Delhi and of all those present today, I thank you for coming here on this historic occasion. I have the honour to request Your Excellency formally to open the Congress ; but first I will ask you to permit Professor Hill to exercise the powers which have been delegated to him by the President of the Royal Society and to perform a ceremony which is without precedent not only in India but also, I believe, in the history of the Royal Society itself.

With due ceremony—in the presence of a great gathering of Scientists representative of India, and of India's Viceroy, Members of his Cabinet and of Illustrious Citizens of Delhi, Prof. A. V. Hill, impersonating the President of the Royal Society of London for Improving Natural Knowledge; admitted to that Society as Fellows, Sir Shanti Swarupa Bhatnagar and Professor H. J. Bhabha.

Prof. Hill then read messages from Sir Henry Dale, President of the Royal Society and also from Sir Richard Gregory, Field Marshal J.C. Smuts and from the Rt. Hon'ble Mr. Winston

Churchill who said : " It is the great tragedy of our time that the fruits of science should by a monstrous perversion have been turned on so vast a scale to evil ends. But that is no fault of science. Science has given to this generation the means of unlimited disaster or of unlimited progress. There will remain the greater task of directing knowledge lastingly towards the purposes of peace and human good. In this task the scientists of the world, united by the bond of a single purpose which overrides all bounds of race and language, can play a leading and inspiring part." Both Mr. Churchill and Field Marshall Smuts sent congratulations to the newly elected members.

His Excellency Viscount Wavell, Viceroy of India, formally opening the session said that " India, one of the oldest civilisations, has perhaps felt the impact of modern science later and less than any other great people. A large proportion of her population still lives the old life untouched by the vast changes of this century. Her realm has been of the spirit rather than of the earth. It may be said of the West hereafter that we took too much from India materially and too little spiritually.

But if India is to play the part in the world to which her size, her population, her history and her position entitle her, she too must make every possible use of scientific advancement. She has already produced many great scientists, she bears many more in her fertile womb. Her contributions to science have always been on the side of

peace and progress. She has everything to gain by combining modern science with her old culture, her traditional outlook should enable her to make an increasingly fine and characteristic contribution to natural knowledge. Indian science has, in fact, made a very remarkable stride forward during the last 25 years, as is shown by the foundation of many new societies, new journals, and new departments of science in Universities and under Government.

In this war science has played a great role in India as elsewhere. It has made a splendid contribution to maintaining the health of the fighting men, through the activities of such bodies as the Malaria Institute, the Indian Research Fund Association, the Nutrition Laboratories at Coonoor, and others. It has also played an important part in munitions production and in solving problems of supply. As an ex-Commander-in-Chief, I should like to thank Indian science for the invaluable assistance it has given to the armies in the field.

It must play a great part also in post-war development. The coming years will be vital to India. She must learn to make use of her abundant resources with the aid of science, which is the most international of all human interests. Professor Hill has himself said in an address elsewhere: "I believe that the pursuit of knowledge for the welfare of mankind is one of the greatest agents for goodwill between men in every land." It is in that belief that he is here today.

This session of the Indian Science Congress has a momentous task to perform ; to discover how best to bring the aid of science to the development of India's great resources in agriculture and industry, to the improvement of health and to social advancement and prosperity. This Science Congress is a body of high repute, with a great and growing membership and influence. Gentlemen, I wish all success to your deliberations."

CHAPTER VII

The Bhatnagar Family

The name *Bhatnagar* that has become so familiar through the brilliantly successful career of Sir Shanti Swarup, indicates one of the four principal sub-castes of the *Kyastha* community. The other three are Mathur, Saksena and Srivastava. The name of Bhatnagar had not been used by Sir Shanti's antecedents either on the maternal or the paternal side. Shanti Swarup Bhatnagar is a heretic in matters relating to communalism, sects, ritual, customs and orthodoxies of every kind, but it so happens that in the matter of caste he has been a strict adherent. He himself married a Bhatnagar and his elder son and elder daughter have followed in their father's footsteps by marrying Kyasthas who are both Bhatnagars.

The *Kayastha* community is a writer community and the correct prefix is *Munshi*, which means a scribe. It is interesting to note that some eminent Indian scientists of our day are Kyasthas. At least three great men of science belong to this community. The late Sir Jagadish Chandra Bose was a Kyastha, Sir Profulla Chandra Ray,¹ is of the same community and also Sir Jnan Chandra Ghosh. Among Sir Shanti's researchers are several Mathurs.

Whatever may or may not be the hereditary and possibly eugenic significance of caste, the Bhatnagar line in Sir Shanti's family is to conti-

1. Now deceased.



FOUR GENERATIONS

Sitting from left: Dr. Ramesh Prashad, Lady Bhatnagar, R. S. Raghunath Sahai with his great grand daughter, Mrs. Raghunath Sahai, Sir S. S. Bhatnagar.

Standing : Devendra, Mrs. Anand Swarup, Sudha Rani, Santosh Kumari, Anand Swarup.

nue, in at least two of his four children. Santosh was the first to marry. Her husband hails from Rajputana and their home is in Bikaner where Dr. Ramesh Prashad Bhatnagar is Surgeon in the State Hospital. To them on the 15th October, 1943, was born a baby girl, making of Sir Shanti a grand-father at 49, Santosh's elder brother Anand Swarup married Shakuntala Bhatnagar on the 11th July 1943. Her father is an old Sikan-derabad school-fellow of Sir Shanti. The two younger children, a girl and a boy—Sudha and Davendra—are at college and school. Sudha was born in 1927 and Davendra in 1929. At the Indraprastha College Sudha is one of about 300 girls and is studying for her B.A. Indraprastha is the old name for Delhi. The college is on the Alipore Road, away from the populous part of Delhi and is set back from the road in large grounds, which during recess hours are thronged with animated, free-mannered, unselfconscious and unfettered girls—the women-to-be of the new India that is in the making, socially as well as industrially.

Davendar is his father in little—never so happy as when he is busy in the small laboratory that is his very own. He has commandeered a room at the end of the front verandah of his father's bungalow where he plays the magician and sometimes the most trying odours pervade the air of the verandah, odours that can only be pleasant or tolerable to ardent chemists. Davendra nearly asphixiates himself in his small lab and has strict injunctions to keep both window and door open while working. He is a lucky boy, for when equipment is needed he goes off with a

handful of money to the right kind of shop and buys what he wants. I was with him one day on his quest and sat a very long time in the car while he was buying, but he returned empty handed. "They think me a child" he exclaimed with indignation. The price he had been charged seemed to him over high, so he found another shop in a back street where he got all that he wanted for about half the price. He returned in triumph to his lab. It remains to be seen if this well stocked miniature laboratory of his will lead to any triumph in research such as did his father's first lab, in which the equipment was more or less of bits and pieces.

Lady Bhatnagar is happy in these days with her little grand-daughter and her garden, both of which she finds of absorbing interest. Santosh is on a visit. A few days ago her husband was here and at the same time her maternal grandparents. Rai Saheb Raghunath Sahai and his wife—four generations. It was something of a problem to get them all together for a group photo. Grandfather Sahai was away on a visit but due to return at 3 p.m. The babe's father had to leave for the station at 4 p.m. on his way back to Bikaner. Sudha was at college, Davendra at School and their father in his laboratories at old Delhi. At about 3.30 the muster of the four generations was complete and Dr. Romesh Prashad caught his train.

The house and garden of Sir Shanti's home in New Delhi are spacious, particularly the garden, where they all revel in its peace and beauty—its shade or its sunshine. Official residences in New Delhi

Genial Host.

stand in ample grounds that form miniature parks round the bungalows ; with extensive vegetable gardens, well removed from the lawns.

Here Sir Shanti has scope for entertaining and his capacity for playing the part of genial host has full play.

After the Science Congress of 1944 Prof. A. V. Hill was his guest for some days and Sir Shanti in his social element. Luncheon and dinner parties were given pretty well every day with a swift succession of highly placed persons in the official world of New Delhi and their wives, as guests.

Sir Shanti has an unrivalled opportunity of contriving contacts in his house of opposing forces, under the restraint of their courtesy-kinship as fellow guests. Personal contact counts for so much in the mutual rubbing off of rough corners, and often in the mutual modification of views and attitudes. The industrial surge that has come, due to pressing war needs, having given a tremendous impetus to industry, industrial magnates are much to the fore and their fifteen-year plan is giving officials and non-officials, parties and partisans, furiously to think. That India is in the throes of an industrial revolution there can be no doubt. At the moment it is hard to see the wood for the trees.

One of the outstanding contacts during Prof. Hill's visit was that of the Finance Member of the Viceroy's Executive Council and a leading industrial magnate. It was at lunch and the table was between them, with Sir Shanti as genial host, a restraining element. When the recent food tragedy was touched upon the hos-

phere became surcharged—emotion and cold intellect fronted each other. I was sitting next to the warm element and faced the cold. The intellectual power, the mental grasp and the unflinching resolve that played on the countenance of the industrialist will surely sweep all before it.

Men and parties, officials and non-officials, rulers and ruled, cannot but pull their weight in the titanic struggle to make the world safe for humanity. This our Indian ferment is but a fragment of world ferment and happy the host who can bring together under his roof persons who should meet in the flesh that they may complement each others' capacities; for it takes all sorts to make a world.

On March 10th, three days from the time of writing, Sir Shanti was due to
Over to China. fly to Chungking, whither he had been invited by the Chungking government. Professor Hill was to have gone too but is not able to do so, and Sir Shanti has had to postpone his flight but it cannot be for long for soon he is due to fly to England.

The mercurial atom named Shanti, is still mercurial—immensely so. The word *Shanti* has falsified his father's hopes for it has had little effect on the temperament of his off-spring indeed how could it? His temperament came into the world ready-made on February 21, 1894.

It is this temperament that has got such a rapid move-on. Small wonder that as Puck, he spoke with such conviction:

"I'll put a girdle round the earth in forty minutes."

Post Script.

FOREWORD TO POSTSCRIPT

*On the Road. At the Staging Bungalow,
Pathankot.*

16 February, 1947. It has been said that the most important part of a woman's letter is in her postscript. Whether this will be so in the lines that follow remains to be seen. At the moment India is seething with political ferment and in the grip of a protracted deadlock. On a political basis it is doubtful if that deadlock can end. On a cultural basis it could. Culture is one, embracing the cultivation of man, seed and the world itself. The part that scientists are taking in cultivating the seeds of War or Peace will affect not only Peace in our Time but the very existence of Time as we know it. According to the use made of atomic energy humanity will go back a thousand years or forward to a millenium. The one would come about on a power basis and the other on a culture basis. The question of questions is: Can scientists protect their discoveries, directing them for beneficence, or, must they submit to their being exploited for its opposite?

27 February—at Andretta in the Kangra Valley.

A word about the book as it stands without the postscript. It was written at New Delhi

during the months of January and February 1944, in the house of Sir Shanti Swarup Bhatnagar, since when it has been 'resting'—although it has travelled far. Originally a commission from a Biographical Research Society in America, it missed the last day for sending in. It might of course been put on for the next financial year but the fact remains, it was not. Instead it had an airing abroad to the United Kingdom and the United States of America, reposing in the baggage of a science delegate to those countries. It returned without, possibly, having seen the light of day, at least it was offered to no publisher. Two abortive attempts at publication were then made, one with an English firm in India and one in Britain. A few days ago, on February the 8th, it came to the notice of a Lahore publisher who is specializing in biographical sketches of noted Indians. We had met quite casually on that day at a popular Coffee House and within a week we had come to terms. While I was still negotiating with him Sir Shanti came to Lahore on a flying visit in connection with a call from the Punjab government. He is wanted back in the Punjab and a conversation on the subject was to take place between him and H. E. the Governor on the afternoon of the 10th February to discuss the possibility. At 10 a.m. that day I was due to meet him in his own house at Lahore where Devendra, now a science student at the Forman Christian College, occupies the roof flat. A tonga strike was on, manoeuvred by the Muslim League and on arrival at 8 a.m. at the railway station Sir Shanti found himself

marooned. His house was a good three miles away. Luckily, he fell in with a friend who had a car which for the rest of the day became his. I was still further away on the outskirts of Lahore, my nearest tonga stand being a mile away. No tonga on the stand. I walked on three miles more to the house of a friend who himself drove me to the Bhatnagar's house that was yet one mile further. Devendra appeared on his bicycle at the same time as I did. He took me up. Arrived in the courtyard a cheery greeting from above caused me to look up and there looking over the roof parapet was Shanti's "shining morning face" beaming at me.

"Don't come down!" I shouted up, but by the time I had climbed about a dozen steps we were clasping hands.

"Congratulations!" he exclaimed.

"Why?"

"Your Drama scheme through."

"It is not," I replied. "It has been turned down for the second time." We stopped dead on the stairs. He was distressed and indignant.

Soon, on the spacious roof terrace we were breakfasting in the sun, Devendra playing a very active host.

"Why do you put yourself about?" said his father. "And why do you not get rid of that junk?" In a corner of the roof, neatly stacked, was a pile of discarded things.

"Your mother was the only person in the family who could have turned it to some use—but she has left us. Sell it."

Devendra's mother had died in early February, 1946, after a long illness—a cruel blow that has profoundly affected the private life of Shanti Swarup Bhatnagar. His public life is self-existent—it always has been. The 10th was to be a full day for S.S.B., leaving at night for Delhi. He dropped me from his borrowed car at a convenient spot and as we parted he said, "If I return to the Punjab, which I fear is doubtful, I am likely to become Vice Chancellor of the University . . . I shall expect you to tea at Lorang's at 5."

We met at the time appointed, where a fellow guest was Dr. Carter Speers, at last beginning to look venerable. The interview with the Governor had not resulted in an agreement with the Central Government proposition so the University of the Punjab will not be under the protecting wing and nurturing care of S. S. B. Cultural and scientific matters call in the Punjab but at Delhi the call is for administration. The wish of many of us is that some day Sir Shanti may be permitted to return to the Land of the Five Rivers where so much of his life span has been spent and where his own spacious house awaits him. Here he might crown his scientific work by administration in the University, becoming a cultural dynamo, as he has been and is, a scientific one.

Meanwhile, away in the recesses and quietude of the Kangra Valley, I await the material

from Delhi that will enable me to collect some rolling drops of "Simab" that I may fix them in the pages that are to complete the book that gives a glimpse into the life of the mercurial atom that is Shanti Swarup Bhatnagar.

N. R.

“ Lajwanti ”

Since the passing of Lady Bhatnagar a book of verses, bearing her name, has appeared from the pen of Sir Shanti Swarup. Indeed this collection was practically made by her, unknown to Sir Shanti until he opened a box that in her lifetime she had kept locked. He found therein a collection of his scribbled verses that she had gathered from his pockets, or found lying about.

From childhood S. S. B. had enjoyed listening to poetry and soon began occasionally to write verse. He was in the habit of writing down verses on any scraps of paper and pocketing them. This usually happened while travelling or on holiday. For years his days have been too full for systematic writing, although for a busy man his output is considerable. He versifies all kind of happenings—a meeting with Mr. Churchill, for instance, and Mr. Amery, called “*Thigani Sircar*” (Short-statured Rulers). In this, the quality of their conversation emerges and incidentally his reactions to foreign ways of life and also some political reflections. “*Farangi Musafar*” (Foreign Fellow-Traveller), a clash in railway compartment in India with a British sergeant, gives him matter to versify. It is a common enough clash but in verse a subtle something emerges that is usually absent from such deplor-

able happenings. On the whole, his verses are topical, humorous and reflective. Those written after the loss of his wife bear a tender wistfulness and the stamp of loneliness. In them is not only his own at losing her but also her loneliness in having lost him in his work. This is an ever-present occurrence in every marriage where man's life in the world cannot fully be shared by woman in the home. "*Ghar ki adhi, bahir ki sari*" is a Punjabi proverb, meaning that half of the inner that is home, is worth more than the outer, that is the world. It is a woman's proverb and applied by her as home-lover and home-maker to those who roam; the implication being that Home is the whole and World the half. But who shall say which is the greater—the world or the home? In Sir Shanti's case the unselfishness and self-abnegation of his wife in all home matters and her superb housewifely qualities made it easier for him to live his outer life to the full and thus build the half on the whole, if only half it is. The blunt fact is that the world is built on the home and the home-maker in this building is to some extent sacrificed. Yet another proverb asserts: "The half is greater than the whole", which gives us food for thought. The word *home* stands for family welfare; it implies at the very least a sufficiency for all men of food, clothing and shelter—the sufficiency that science in our day is endeavouring to bring about.

"*Bibi aur Kitab*"¹ in fifteen couplets expresses the loneliness of the home-maker.

¹ "Wife and Book"

Lajwanti speaks :

“ Had I but been a book
You would ever have looked my way.

My forehead, being part of that book,
Would have felt your touch as you turned its
pages.”

Another Lajwanti poem has poignant significance. It is called. “*Salgirah*.”¹ In their garden at Delhi was a patch of peas into which it was understood the family could wander at will, plucking and eating them. While staying in their house in New Delhi in 1944, during my afternoon rest hours in the garden I often saw S. S. B. standing among the peas in happy forgetfulness, plucking and enjoying them. I can picture him on his first birthday without Lajwanti, late in the very month she had died, wandering disconsolately in the garden and coming upon the peas. Hence the poem.

“ Be happy on your birthday !
Alas, that I am so far away.

You believed not in Fate,
Yet Fate has parted us.

That I might fly to you on wings
And laughingly make you smile !

What gift have I to offer you,
Being so far, so far away ?

1. “ Birthday.”

These peas—I sowed them with joy,
Little knowing I should not see them ripen.

These peas are my birthday gift.
Pluck, eat—enjoy their sweetness.

So Lajwanti has become the book she wanted to be and many will turn her pages. This is a lovely and lasting tribute to the home-maker from the scientist to whom the world is the whole.

Overseas

The flight to China by Sir Shanti Swarup did not come off, although the Goodwill Mission to the United Kingdom and the United States of America was considerably postponed. On this Mission, Bhatnagar as spokesman, was accompanied by his old friends and fellow-"Musket-eers" Sir J. C. Ghosh and Dr. K. N. Mukerjee. Other members of the party were Dr. Meghnad Saha, Dr. S.K. Mitra and Dr. Nazir Ahmad. They arrived in London by air on October the 11th, 1944 and seven weeks in England were well filled with all manner of engagements, scientific, industrial and social. Technical Institutes, Universities, Clubs and Societies inundated them with invitations. Not a day was free. Industrial war-works particularly interested them, being a goad for peace-time activity as in India. In the matter of economic development no field was left unexplored.

One of the outstanding social entertainments in England was a luncheon given to the Indian Scientists by the Indian and Eastern Newspapers Society whose president is Sir Stanley Reid. Many leaders of British industry were present, including Sir Handley Page, Sir William Rootes and also, Sir George Nelson, Chairman of the Federation of British Industries.

Bhatnagar, addressing the company after lunch, said that the idea was prevalent among his countrymen that Britain was unfriendly to the industrialization of India and yet wherever they went they found British leaders in all walks of life eager for the success of Indian industry. Fundamentally, of course, they knew that a prosperous India was to the interest of industrial Britain. Nevertheless, he and his brother scientists had been forcibly struck by the friendly co-operation of which there were signs on every hand. Sir Shanti spoke of the complementary needs of Britain and India. Britain having the scientific and industrial skill and also, experience, but being short of the raw materials for industry, while India had the latter but was backward in the former. Thus, there was need for mutual co-operation and they, as Indians, were ready. This remark drew from Sir George Nelson the admission that British industry had been labouring under the impression that Indians did not want their help but preferred to proceed entirely by their own efforts. The co-operation of which Sir Shanti spoke was precisely the line upon which British industrialists were most anxious to advance to their mutual benefit.

At a reception given at India House by the High Commissioner for India the Indian scientists met Mr. Amery, the then Secretary of State for India, and Major Atlee, then Deputy Prime Minister and many other distinguished people. The Mission visited leading university centres where they discussed with the authorities ways and means for the admission of Indian students

for technology and for research. Among the centres visited were Oxford, Cambridge, Manchester, Sheffield and Edinburgh, where the scientists not only saw the work that was going on but had the great advantage of making personal contacts with both scientists and industrialists. At many of the places they visited they were given civic receptions.

Before they left for the U. S. A. Sir Shanti was invited to address the East India Association. The idea of confronting such a highly conservative body rather apalled him but when he found that his old friend Prof. A. V. Hill was to preside he took heart, feeling that he could safely unburden his thoughts under the protection of his chairmanship.

Sir Shanti began in his own characteristic outspoken manner. "Those of you," he said, "who know the ways of the government of India, will be wondering how some of the proposals that Prof. Hill made to that government have escaped subjection to the cold storage treatment which is applied to all proposals submitted to the Imperial Secretariat in New Delhi, the duration of the treatment being directly proportional to the degree of the novelty of the proposals concerned. That some of the schemes suggested by Prof. Hill should have been sanctioned within a few months was nothing short of magic. Therefore Prof. Hill must be a magician, though he stoutly denies it. There is no doubt, however, that the short stay of a scientist has produced more lasting effects on Indo-British co-operation than have the goodwill missions of

politicians. His Majesty's Government will advance the cause of our mutual relationship if they send a few more Englishmen of this type to India." Sir Shanti's address to the Association was on "Science and Industrial Progress in the New India" and he prefaced his remarks by assuring them that India was awake and critical as never before. In his closely reasoned and fearless exposition of the subject he typified India in her new mood of awareness.

"Far-sighted thinkers," he remarked, "in the economic and industrial fields are now thoroughly opposed to the use of economic power to exploit or pauperize an undeveloped nation. Not only ethical principles, but even materialistic considerations have led to the view that the further a country progresses from economic poverty to material prosperity the more it will buy from others. No thinking man will doubt the soundness of this idea. In essence, it is the policy of live and let live.

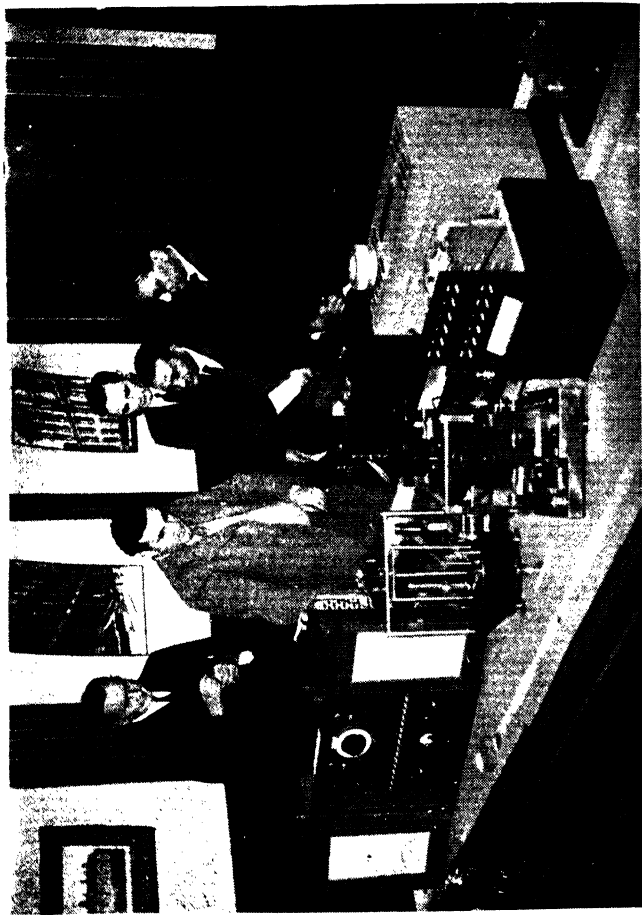
Touching upon the future relationship between England and India, he declared that a scientific approach to harmony in that relationship lay in a final and honourable settlement between the two countries, followed by an understanding that there will be trade and political agreement which will guarantee planned industrial progress for both. "I am among those Indians who want intimate friendship and intense co-operation with Britain. I go further and say that there are still, indeed, many Indians who wish to be friendly with Britain, within the British Commonwealth. I agree with P. M. Hill

that disaster lies ahead if India's industrial development and national welfare are not immediately attended to. Political controversies may take time to settle but India's national welfare cannot wait." On the subject of the pooling of capital Sir Shanti had clear-cut views. "Common money is like common blood and leads to a cementing of good relations when it is shed in a common cause. I am convinced that if in the past Indian and British business men had co-operated in enterprises brought into being by common capital many political obstacles to industrial progress would long since have disappeared." In concluding his address Sir Shanti said that the scientific approach to India's tangle was more likely to create results than any other. Scientists were more international-minded than other men and none saw so clearly as they did that the implications of discoveries and inventions, if not properly used would lead to dire consequences to humanity.

A full and frank discussion followed the address in which Mr. Amery took a leading part.

The East India Association also arranged a reception in honour of the Indian Scientific Mission at which was assembled the largest gathering of scientists in its history. Madame Curie-Joliot was among those present.

The Mission were entertained by His Majesty's Government at a special luncheon at which the Deputy Prime Minister presided, Mr. Winston Churchill not being present. Mr. Amery read a letter from the Prime Minister regretting that pressure of work did not permit



Visit to a Laboratory in U. S. A.

Sir S. S. Bhatnagar and Sir J. C. Ghosh with some American Scientists.

him to meet the Indian scientists personally but that he watched their work with interest.

In a press interview, as the Mission were about to leave for the U. S. A., Sir Shanti, questioned about the transfer of power to India, advocated a speedy move in the interest of Britain herself. As for the colonies, he suggested it would be better in the long run if they could get Britain to join the Commonwealth rather than that Britain should attempt to keep the colonies within the British Commonwealth. India was no doubt implicit within this remark. It was imperative, he said, to think of India in terms of equal and honourable partnership with Britain and the Dominions. Scientific and industrial development was a sure way of beginning this relationship.

In the States, where eight weeks were spent, they saw all the leading centres of research and industry, in which even the film industry at Hollywood was included. Everywhere they were warmly welcomed and freely entertained—it was a veritable triumphal march. The State Department held a reception in their honour. Sir Shanti felt that all these contacts were allaying the fears that India was resisting help in the industrialization of their country and that India was antagonistic to America.

American institutions vied with one another in their hospitality. Visits to industrial laboratories included The Radio Corporation of America, the Bell Telephone, the General Electricity, Shell Development and American Cynamide companies, also the laboratories of Du

Pont, and the Industrial Solvents and the Carnegie laboratories. They also visited the Massachusetts Institute of Technology at Boston, the Carnegie Institutes at Washington and Pittsburg, the California Institute of Technology, the Mellon Institute and many other places. No important university was left out. This hard work was occasionally relieved by social events and many personal friendly contacts.

At Padsena, The California Institute of Technology, under the presidency of the celebrated physicist Dr. R. A. Millikan, a dinner was arranged in honour of India's distinguished visitors, after which all manner of questions were fired at them. The fusillade had to be met and particularly brilliant were the replies given by Sir Shanti to a certain doctor who was among the guests. This questioner was critical of India's industrial development and started off by asking whether India had any gold left as America would not go to her help unless she was paid in gold. Bhatnagar retorted by saying: "I and my colleagues have just come from England where we told that all India's gold as well as Britain's was held in the Washington treasury and Americans were honest people." Another question asked by the same fellow-guest was whether the Indian scientists noticed anything which came late in America in contrast with everything which was late and slow in the East? "Yes," came the quick reply from Sir Shanti, "old age—and all the accompaniments of it, including wisdom." There was an uproar of laughter at this and the doctor complimented Sir Shanti upon

his witty and skilful replies. He had in fact been greatly impressed by all the replies of the Indian scientists. The wealth of information and wisdom they contained was remarkable and he could but surmise that they were all well advanced in years and yet they had not a grey hair between them. "Could they tell us the secret of their youthfulness and dark hair?" Bhatnagar rose immediately and smilingly addressed the chair asking whether a frivolous question might receive a frivolous answer. Being assured by Dr. Millikan that that was what was expected, Bhatnagar replied, "It is because in India we do not spend sleepless nights thinking of blondes!" At this there was hearty laughter and vociferous cheering. Bhatnagar learnt afterwards that the cap had fitted the doctor.

On another occasion Bhatnagar's wit caused much merriment. It was at a gathering to meet the Indian visitors in the house of Prof. K. T. Compton in Boston, Mrs. Compton presiding. Boston girls said they had many pen-friends in India and asked the Indian scientists whether they had any pen-friends in America?

"Speaking for myself," said Bhatnagar, "I have many real American friends but the only pen-friend I have in America is my Parker 51, and even that friend slips out of my pocket now and then."

Before they left the States they went on an inspection tour of the Tennessee Valley to see the miracle of transformation brought about by the T. V. A.

Sir Shanti was to have been the President at

the Indian Science Congress to be held early in January, 1945 at Nagpur, but since he was not able to return to India in time his address was read for him by Prof. S. N. Bose, the past President.

In this he stressed the role of Science in the advancement of man. It was tragic that a ruthless war and almost universal bloodshed should have been the stimulus to the high levels to which scientific invention and ingenuity had risen. It is obvious that science can and must play an essential part in human development in the immediate future. Unless opportunities are provided for science to explore the possibilities of human development a better world cannot be created.

Honours continued to shower upon the head of Shanti Swarup Bhatnagar. In 1944, during his absence overseas the honorary degree of D.Sc. was conferred on him by the Patna University. In 1945 he was elected an honorary Fellow of the British Society of Chemical Industry in recognition of his outstanding services to industrial chemistry. In April of the following year he was honoured by being made a Fellow of University College, London. In the same year the honorary degree of Doctor of Science was conferred upon him by the University of Oxford in a Convocation held on the 1st of July. The following is an abstract from orations delivered by the Public Orator.

Prefatory.—"The University has lately given its welcome to those who conducted our air warfare and to 'great leaders by sea and land,

each with his own record of hardships overcome.' Success in war is attributed by common consent not only to the planning of military chiefs and to the bravery of the armed forces, but also to innumerable scientific calculations and innumerable inventions of applied science. Nothing, therefore, could be more timely than the presence in Oxford today of scientists gathered together from all parts of the Empire—men who in war-time aimed at speed of action and at co-operative effort by referring scientific problems to a central authority (the British Commonwealth Scientific Office) and who, with the return of peace, have both the power and the wish to contribute, by a great variety of means, to our common well-being. In token of these feelings let academic honours be conferred without further delay upon four representatives of the Conference, all of them men whose professional eminence has been recognized by Membership of the Royal Society.

Sir Shanti Swarup Bhatnagar, F.R.S.

Here is one whom London once made welcome as a young research scholar from India; he was to study for two years in the William Ramsay Laboratories there, so that afterwards he could apply the results of scientific research to industry. Now, in his maturer years, he is Director of Industrial Development on the Advisory Board of Scientific and Industrial Research for the whole of India. The reasons for his eminence are not far to seek. Soon after his return from London he went as Professor of Chemistry

to the great city of Benares. Three years later he returned to his own University (of Lahore) which permeates and enriches the 'Province of the Five Rivers' from its fount of learning. There his professorial studies, extending over a period of sixteen years carried his name into all parts of the world. You may learn from them the influence of light on chemical changes; the nature of colloidal substances, or the magnetic power and effects of substances which interest the chemist.

I present for the honorary degree of D.Sc., Sir Shanti Swarup Bhatnagar, F.R.S., a tireless intermediary between the Sciences and the Arts.

In 1946, Sir Shanti Swarup Bhatnagar again flew overseas. This time he was leader of a delegate of Indian scientists to the British Commonwealth Scientific Conference that was formally inaugurated by His Majesty the King, on the 17th June.

"The primary purpose of the Conference was to provide an opportunity for exchange of views upon scientific problems of practical importance to the scientists throughout the Commonwealth, and in particular, to survey the progress made during the war years. The Conference surveyed the entire field of scientific work and made recommendations about the ways and means of achieving the greatest practical measure of collaboration between scientists and organizations in the various parts of the Commonwealth for the solution of scientific problems of common interest. The successful war-time

collaboration in scientific research between the units of the British Commonwealth on the one hand, and the United Kingdom and the United States of America on the other, raised the important question of continuing and strengthening scientific collaboration through permanent liason machinery to be established for continuing the good work."

This passage is quoted from a Note by Dr. K. N. Mathur who was Secretary to the Indian Delegation, assisted by Mr. R. C. Sharma, Dr. Bhatnagar's Personal Assistant.

The Conference was in two periods, the first of which (unofficial) was held under the auspices of the Royal Society and lasted for three weeks, the first week being spent in London, the second in Cambridge and the third in Oxford. The Commonwealth Conference (official) followed in London and covered a period of two weeks.

There were eight official delegates of whom Bhatnagar was one; among the others were Dr. J. N. Mukerji and Khan Bahadur Mian Afzal Hussain. The six non-official delegates included Sir J. C. Ghosh, Dr. M. N. Saha and Dr. H. J. Babha.

During the first week the Commonwealth delegates met for informal after-dinner discussions for which no formal papers were prepared. Among the subjects were Nuclear research, scientific aspects of Radio communication, Cosmic rays, Fishing industry, Soil surveys and on

These interesting evening discussions could not be maintained in Cambridge and Oxford.

In Cambridge, among other subjects for discussion, was a survey of the problems of agricultural science in the Commonwealth, and the need for a further survey of its mineral resources on a more adequate scale than hitherto and with more up-to-date methods.

At Oxford, an address was given by Sir Henry Tizard at Rhodes House and a reception by the Mayor. Some of the discussions that took place were on Agriculture, Forestry and the science of Nutrition.

The official Conference that followed, in London, was formally opened by the Rt. Hon. Mr. Herbert Morrison, Lord President of the Council.

“This Conference considered in detail the recommendations made by the Royal Society Conference with a view officially to initiate suitable action. It had been anticipated that many of the decisions which would be taken at the Royal Society Conference might require a background of Government policy and perhaps official support for their full implementation. The Official Conference following the Royal Society Conference was thus a desirable complement to it.” (K. N. Mathur Note).

At both conferences, Bhatnagar's advice was sought for, in drafting resolutions and in arranging agenda. During these conferences he showed qualities of leadership, in which he is, so far, unmatched by any scientist in India. The secret

may lie in his sincerity of purpose, unfailing courtesy, his solicitude and his respect for the opinion of those under him. Underlying all is a deep inner consciousness of human values.

“In the Official Conference each leader of a delegation was asked to preside in turn. Bhatnagar was assigned the very important subject of “Seconding and Interchange of Scientists throughout the Commonwealth” in which subject he had been deeply interested for years.” (Mathur)

The many social functions held in honour of the overseas delegates provided invaluable opportunities for intercourse between them and British scientists and industrialists. Receptions were given by the High Commissioner of India, by His Majesty's Government, by the Parliamentary Scientific Advisory Committee, also, they were bidden to an evening party at Buckingham Palace. Both at Oxford and Cambridge the round of social engagements continued, of private luncheons, dinners and teas, when many stimulating personal contacts were made.

Soon after Sir Shanti Swarup and his companions had arrived in England he had been told that he had been chosen to propose the toast of His Majesty's Government at a dinner that was to be given by H. M. G., after the official Commonwealth Conference. He demurred, feeling that he was hardly the right person to do so, since in no country in the world had His Majesty's Government been subjected to so much criticism as by his own. The New Zealander, he went,

who was to reply for the guests had been selected by a toss. Let that also, he suggested, be the method of choice in toasting H. M. G., but in reply he was told that he could not get out of it. So after the dinner, Sir Shanti found himself on his feet doing as he was bid, in his own humorous fashion, as thus:—On his last visit to England in 1944 he had had his first dinner in a Morrison Shelter and although their dinner that night was also under the shelter of the Hon'ble Mr. Herbert Morrison there was more air and more space about it and signs of returning pre-war gaiety were visible around them. He supposed that asking an Indian to propose the health of the British Government was a diplomatic move, since, being under the influence of good food and good wine his acerbity might be sweetened. If that were so, in choosing him they had overlooked the fact that he partook neither of meat nor of wine. These chemical aids to pleasantness, for him, would be of no avail. However he could not let the opportunity slip of presenting bouquets to the Cabinet Three who had braved the worst months of an Indian summer in order to attempt a political settlement so that "our two lands could be united in that bond of friendship which freedom-loving people all over the world understand and value." He capped his compliments to the Cabinet Mission with one or two anecdotes. Mahatma Gandhi had said of Lord Pethick Lawrence, "I can see through his soul. He is a genuine friend of India." "No small compliment," said Sir Shanti, "the souls of so very few Englishmen being transparent to the

Mahatma's gaze." Yet another anecdote from the same source. Sir Stafford Cripps being an old friend, took the Mahatma for a drive in his car. Gandhi wished his host to step in first, at which Sir Stafford, with his usual charming smile, said, "I would be glad to give you ownership of your country, Gandhiji, but I could not give you ownership of this car." With an equally charming smile the Mahatma replied. "None of your lawyer's tricks with me, Sir Stafford. This car belongs to the Government of India and I thought you were prepared to give me the larger share in it." Sir Shanti was optimistic about the solution that ultimately, he believed, might follow the Cabinet Mission attempt, although at the moment there was little sign of a settlement. He paid a hearty tribute to the Hon'ble Mr. Herbert Morrison, their Lord President of the Council who reigned over the scientific activities of the United Kingdom. He had learnt on very good authority that to this Right Honourable Gentleman no expenditure on Science was either a luxury or a necessary evil.

"While a great believer" said Sir Shanti, "that many problems which in the past were considered political can be better tackled by the scientific method, I am not one of those who would advocate the formation of a Cabinet in England consisting only of Fellows of the Royal Society or Doctors of Science from the learned universities. This would not only render day to day government impossible but what is worse, it would take away from the scientific field a great many minds into places where their talents would

be of little value. Nevertheless, the impact of science on political problems is very real and cannot be ignored. In some cases it is the only method likely to succeed in their solution.

Sir Shanti spoke of the very great advantages of a Conference such as theirs that His Majesty's Government had been pleased to finance, quite apart from the academic value of their discussions. These were the renewing of old contacts and the making of new ones. "We also begin to understand and appreciate the nature and qualities of our opposite numbers in the United Kingdom and the Commonwealth. This makes co-operative effort better and easier."

Here spoke one to whose country, pilgrimage as a cultural force has been an ever-present factor in the unification of her peoples. His speech was punctuated with hearty applause and the Rt. Hon. Mr. Herbert Morrison in his reply said, "We have just had a really great speech from Sir Shanti. If there were more Indians who could combine frankness with such good humour India and England would be friends for all time."

Pilgrims

For Ages, B. C.

have Hindus from the North and
Hindus from the South
made pilgrimage
from North to South and
South to North—all shackles
cast away—

to acquire merit
for their own souls in a life
hereafter.

They met and fraternized
with other Hindus whose
language, garments and customs
differed: though their object
was the same—

to acquire merit
for their own souls in a life
hereafter.

To their homes they returned, or they died on
the way—well content.

Likewise .

Later, A. D.

have Muslims from the North and
Muslims from the South

made pilgrimage

to Mecca—all shackles cast
away--

to acquire merit

for their own souls in a life
hereafter.

They crossed the borders of their many

homelands, meeting Muslims
from many countries, learning
much of lands beyond their
own

acquiring merit

for their own souls in a life
hereafter.

To their homes and homelands they returned,
or they died on the way—well
content.

Likewise

in the closing years of A. D., on the eve of

A New Age—

When the world was riven with global wars :
When humans starved in the grip of food
pirates :

When many countries pulled one against the
other for power :

When many countries invented and secreted
diabolic weapons of destruction
and massacre—

Pilgrimages abounded.

The Pilgrims

were
Masters of Knowledge
belonging to no particular
religion,
acquiring no merit
for their own souls in a life
hereafter,
but
striving for sure good
for the Here and the Now—
upon Earth.

Always
 were they the means of diffusing
 widespread knowledge of the
 Arts and of the Sciences.

Always did they return stimulated, but not quite content, to their homes and if from overseas, to their own homeland.

Andretta.

14 March 1947.

Homeland

While Sir Shanti had been overseas in 1944, all had not been well in his home at Delhi and the closing days of the Scientific Mission had, for him, been filled with gnawing anxiety on behalf of his wife who had been seriously ill. She had sufficiently recovered to meet him at the aerodrome when, upon his return, he trod once more on the soil of his own homeland.

As time passed it was evident that the strength of Lady Bhatnagar was failing and by the end of the year 1945, her days were numbered.

During this year of home stress for Sir Shanti, the political stress was much as usual except that the approach of the transfer of power from Britain to India was, on every hand, bringing the scum of power passions to the surface. Communal politics were filling the air with provocative words. Through it all Science kept her silent, steady course.

Sleepless nights and wide-awake days still found Bhatnagar at his office desk at the usual hour and often he worked late in the evening. During these months the only sleep he had was snatched at odd moments. Night after night he remained in the sickroom, his presence easing the long night hours of his suffering wife. During

these difficult days Bhatnagar showed the qualities that have always distinguished him. Though inwardly torn with anxiety he showed a cheerful face to his family and friends. His sense of duty and devotion at this time, both in the house and the outside world, made a very great strain upon him. He stood up to it through sheer will-power.

On the morning of the 31st of January, Lady Bhatnagar made her last journey. Sir Shanti, in desperation, had yielded to medical advice and accompanied by their elder son, Anand Swarup, he took her to Bombay for further diagnosis in the Tata Memorial Hospital. All that was possible had been done to mitigate the discomforts of the long journey, with doctors and nurses in attendance in the air-conditioned compartment. Lady Bhatnagar had shown courage and fortitude, was conscious to the very end and most characteristically, herself.

On the evening of the 2nd of February she asked for new clothes, saying she wanted to go for a drive as, so far on this trip, she had seen nothing of Bombay. The nurse and *ayah* brought the clothes, but Lajwanti turned her head away and said, "To-morrow. I will go to-morrow." Then she asked the time and chided her husband and son for not yet having had their evening meal. These chiding words were practically her last—the words of a home-maker.

In the early hours of the next day she passed away, peacefully, in the presence of her husband and nurse. At her request, her

were taken off her wrists—a parting gift to her daughters.

It was in the early days of his bereavement that Shanti came upon the collection of verse that became “Lajwanti.” In those days the only solace he found was in poetry. He wrote verses and he collected them. At his office he worked, and worked hard, but found in it neither comfort nor forgetfulness of his sorrow.

The year of 1946 was an unhappy one in the homeland of Hindu, Indian Muslim, Indian Christian and Sikh. Nor were the British in India too happy. Fortunately for India, the British have not settled in this country and made of it a homeland for Anglo-Indians (old style). There has, in fact, scientifically, never been such a group. Had there been it would not have been so easy to ask them to ‘quit’. For the British in India, *Anglo-Indian* has always been a misnomer, as it is today for the progeny of parents of mixed marriages of Europe and Asia. In this respect, the banned word *Eurasian* was scientifically correct. And now, for Indian Muslim and Indian Christian new designations, more scientific, are called for. Indian Muslims might, for the time being, become *Muslo-Indians* and Indian Christians, *Christo-Indians*. The day, however, will dawn when no Indian will tolerate a separative religious label. That day will be when, scientifically, India is One—when India is India.

1946—It was in 1946 that the Indian Navy **Politics in India.** nearly mutinied and that India nearly starved. Early in the year, a British Parliamentary Delegation landed at New Delhi and, after getting their bearings, made a lightning tour, sampling bits of India here and there, in detachments. At the time, "Pakistan" was very much in the air and in the village detachment a persistent question put by the most vocal and most popular member of the Delegation, was: *What about Pakistan?* "Do you want it? What does it mean? What do you know about Mr. Jinnah? Have you any quarrel with your Hindu or Muslim fellow-villagers?" In fact, this questioner was so persistent on the point that he earned the nickname of "Pakistan" from, at least, one of his fellow-delegates.

In August of the same year an appalling communal clash occurred in Calcutta. By a curious co-incidence it broke out on the Muslim League's first "Direct Action Day" from when has been a crescendo of incredible carnage, arson and bestiality, leading to reprisals in Bihar and followed by sporadic stabbings and assaults in Bombay and elsewhere; and now in the Punjab, streets have been strewn with corpses and cities with rubble. In the short space of two weeks 2,049 have been killed and 1,103 injured and several cities¹ laid in ruins. In the Punjab,

1. The word *city* in India is used only for the over-crowded and congested areas of the old walled cities of the pre-British period. It is in these 'walled' areas that destruction and slaughter have been played.

democratic rule has collapsed, power-passion is rampant and Governor's rule is in force. Police and Military have their hands full.

Before the holocaust that began in August, a British Cabinet Mission came to India, in all seriousness and solemnity, to end the political deadlock—on a political basis. The thing, of course, could not be done because politics itself was the trouble. Deadlock followed deadlock and what was to have been a three-week walk-over became a long-drawn-out affair that ended in stale-mate. The Cabinet Three returned to their homeland, sadder but wiser men. After their departure for home, India played a game of 'interim' see-saw. The players were communalists and non-communalists, in other words non-nationalists and nationalists. The game has developed into a 'constituent' tournament that at the moment is still going on.

This is but one side of the story in India 1946. Another side is brighter and shall be related.

1946—This twelve-month has seen the commencement of a chain of National Research Laboratories and Institutions that will hold their own with any in the world. Seven have been sanctioned, five of which are begun. In December 1945 the Central Glass and Ceramic Research Institute led the peaceful and peace-making procession. The foundation stone of this institute was laid at Calcutta by Sir Ardeshir Dalal, the then Member for Planning and Development in the Government of India. The technological block is

**Science in
India**



At the Foundation Stone Laying Ceremony of the National Chemical Laboratory, Poona.
From left : Principal D. G. Karve, Sir S. S. Bhatnagar, Shri C. Rajagopalachari, Shri B. G. Kher, Sir Ardeshir Dalal

already completed and the other block is very soon to be built.

Next came the Central Fuel Research Institute at Dhanbad, on the 17th November, 1946, when the stone-laying ceremony was performed by the Hon. C. H. Bhaba, Minister for Works, Mines and Power.

Four days later came the National Metallurgical Laboratory, at Jamshedpur, of which the Hon. C. Rajagopalachari, Minister for Education and Arts, laid the foundation stone on the 21st November, 1946.

The National Physical Laboratory followed on the 4th January, 1947, at New Delhi and the foundation stone was well and truly laid by Pt. Jawahar Lal Nehru during the days of the Indian Science Congress, over which he was presiding.

The fifth member of this peace procession is the National Chemical Laboratory, the foundation stone of which is to be laid on the 6th April, 1947, in a few days from the date of writing (26 March) by the Hon. B. G. Kher, Prime Minister of Bombay.

The remaining two of this epoch-making pageant as yet not visible to the naked eye, are the Road Research Institute and the Building Research Station.

These five torch-bearers of the India that is to be, are no mean contribution by Science in a twelve month—built four-square to the winds, they will endure when the political Tower of Babel will have been blown away.

In his opening address at the foundation stone-laying of the Metallurgical Laboratory for

Shanti Swarup said that the truism had been definitely established that the industrial progress of a country bears a definite proportion to that country's metallurgical industry. Metal alloys still reigned supreme in most of the heavy and light industries and in domestic requirements, in spite of the remarkable development in plastics. Each had their own field of application. Sir Shanti revealed that research in atomic or nuclear energy had led to the possibility of making ordinary metals radio-active. This was a revolutionary development in the field of metallurgy. "The effect of this," he said, "would be that a good many metals which hitherto have been regarded as museum specimens may become important in industry." The genesis of that day's ceremony could be traced to the year 1940 when, at his suggestion, the Board of Scientific and Industrial Research set up a Metals Research Committee. In the meanwhile, the Council of Scientific and Industrial Research came to the considered decision that a chain of research laboratories was essential for the progress of the country's basic industries, for the advancement of science and for national welfare.

The Metallurgical Laboratory Planning Committee was helped in its work by the architectural firm of Ballardio Thomson and Mathews who had been responsible for the design and construction of the Tata Iron and Steel Co.'s extensive Research and Control Laboratories at Jamshedpur. The House of Tatas, pioneers in the country's metallurgical industry, with their characteristic generosity, had made a gift of about 12 lakhs

for the establishment of the National Metallurgical Laboratory. Open-handed contributions of one lakh and Rs. 10,000 respectively were made by the Indian Steel and Wire Products and by the Mining, Metallurgical and Geological Institute of India.

Jamshedpur had been chosen for the location of the National Metallurgical Laboratory for the excellent facilities it affords for the study of practical operation problems at the works of the Tata Iron and Steel Co., The Tinplate Co. of India, The Indian Steel and Wire Products and the Indian Cable Co. Sir Shanti remarked that in no other way could they pay greater homage to the pioneers of metallurgical industries in the country than by establishing their National Laboratory in the midst of their achievements. In conclusion, Sir Shanti declared, "There is no force more unifying than Science and through Science we may yet realize One World."

Sir Jehangir Ghandy, Director of Tata Industries Ltd. who presided, reminded his hearers that Rajaji (as Sri Rajagopalachari is affectionately called), in his former capacity of Minister of Industries and Supplies, while presiding over a meeting of the Governing Body of the Council of Scientific and Industrial Research and its Advisory Board, had made an appeal to the scientists not to subordinate themselves to the whims and fancies of politicians however illustrious they might be, but to allow allegiance only to Science and Truth. "Today, Sir, you will be laying the foundation stone of a building which will

is designed to serve as a concrete embodiment of that very cause, namely Science and Truth."

Sri Rajagopalachari, at the conclusion of his address, said, "We are on the threshold of a future, full of trials, heavy duties and great rewards. In the trials and in the duties that await us, scientists and engineers of the country have to take a very large part... Science is a great unifying force and may save us where religion as practised, has not only not availed, but seems to hinder and divide."

Dr. G. P. Contractor, Assistant Director of the National Metallurgical Laboratory, after expressing his cordial thanks to the distinguished persons who had favoured them with their presence, paid a glowing tribute to Sir Shanti Swarup Bhatnagar, "who" he said, "occupies a prominent position in the scientific world. At the outbreak of the last war—indeed at a most crucial period of the country's history—Sir Shanti Swarup showed his abilities as a great scientist, a builder and an outstanding administrator, and set the pace of industrial progress through scientific research. It was mainly through his unbounded energies that a crore of rupees was made available from the Government of India for the establishment of a network of National Research Laboratories to be sited in different parts of the country. As a result of his unceasing efforts in making the Government and the public keenly alive to the importance of research to national progress, we are witnessing today the foundation stone being laid of one in a chain of five National Research Institutes. In the advancement of scientific

knowledge and in the utilization of that knowledge for economic and social regeneration of the country, Sir Shanti Swarup has earned the highest esteem of his countrymen." Dr. Contractor also recorded their "grateful thanks to the noble House of Tatas, and to their distinguished Chairman, Mr. J. R. D. Tata and to Sir Ardeshir Dalal for the munificent donation of twelve lakhs of rupees and for the grant of a suitable plot of land for the building of the Laboratory... Also, we are deeply thankful to Sirdar Bahadur Sir Indra Singh for his very generous contribution of a lakh of rupees for the building of the Laboratory. Sir Indra Singh's handsome donation is not only a testimony of his magnanimity and progressive outlook, but is an example of how our leading industrialists are increasingly looking upon research as the key to industrial prosperity."

Indian National Physical Laboratory.

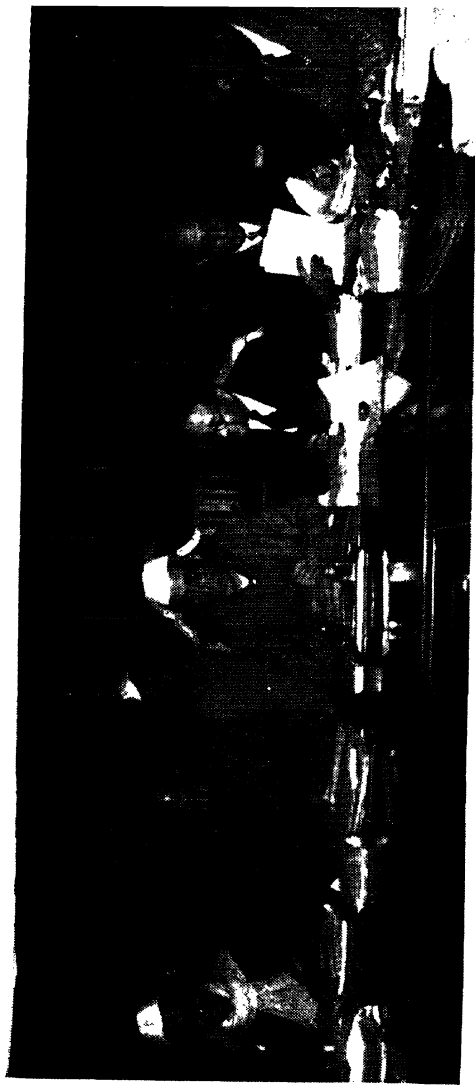
Pandit Jawaharlal Nehru, who was President of the Indian Science Congress, held in Delhi in 1947, should have thus presided (also in Delhi) in 1944, but at that time he was otherwise engaged—busily discovering India within the four walls of his prison cell. Prof. S. N. Bose who had been chosen in his stead to preside on that occasion had made feeling reference to his absence. "Many of us" he had said, "expected that a deliberate programme of the future scientific activities of the country would probably be a feature of the opening speech of this Congress. Pandit Jawahar Lal had studied the needs of the

country. Many of our first-rank scientists and industrialists had met under his leadership not long ago, and given to questions of future reconstruction much time and anxious thought. The results of this deliberation would have been invaluable at the present moment."

Therefore, it was in the fitness of things, and not due to his eminence in the government of the country, that Pandit Jawahar Lal Nehru had been invited to lay the foundation stone of the National Physical Laboratory. This was made clear by Sir Shanti Swarup in his opening address.

"Of all our national leaders," he said "Pt. Nehru was the first to associate himself actively with the idea of National Planning which the scientists and engineers had promoted." Sir Shanti was overjoyed that the foundation stone of this building should be laid by him, and declared that to the end of his days he would remember the ceremony with joy and pride. In the course of his address Sir Shanti said "If India is to play her role as a great nation she has to take an active part in scientific and technological work of an international character quite as much as in the international political sphere. Speaking from experience, I can say without hesitation that the amount of unanimity which the scientists are able to achieve is quite unimaginable among politicians."

Speaking of the location of the Laboratory, he said, "We are particularly fortunate in the present site as we are close neighbours of an Institution which has played no inconsiderable



A meeting of the Governing Body of the Council of Scientific and Industrial Research at New Delhi.
From left: Shri N. V. Gadgil, Dr. S. P. Mookerjee, The Hon'ble Pundit Jawahar Lal Nehru, Sir S. S. Bhatnagar
Sir Ardeshir Dalal, Shri R. P. Bahadur.

part in India's agricultural development—I mean the Agricultural Research Institute right opposite us. The Institute has one of the best libraries on the biological sciences, and between the National Physical Laboratory and the Institute, we shall have the most complete scientific library in India which we hope will form the nucleus of a Central Information Service for all the scientific workers in India."

In conclusion, Sir Shanti said, "These are days of decision for India and if she is to take, as she must, her rightful and honoured place among the nations of the world she will have to grow strong and great industrially... Vast are the fields to conquer, plenty the harvest to reap. It is only the divisions among our people in this ancient land that are holding us back from a leaping march. Here, Science can intercede, with its message of concordance in truth and unity in endeavour. The Realm of Science is bound finally to establish itself. Convinced of the inevitable, we must sink our differences and march ahead in unity."

These stirring words of Bhatnagar spoken in New Delhi with Nehru at his side, ready to lay the foundation stone of the great Indian National Laboratory, were as a beacon shedding a piercing light in the darkness—the darkness that had descended upon this sacred ancient land in 1946 and that is spreading in 1947.

The act of Jawahar Lal Nehru in laying both well and truly, the first stone that was to bear the edifice of a great National Institution, was a symbolic act.

This heartening retrospect of Science in India, 1946-1947, outweighs the distressing retrospect of politics in India for the same period. Science, being compact of elements that are cultural and creative will persist and go from strength to strength; whereas, the destructive and disruptive elements that have flared up on a political basis will die down and perish of their own inanity.

Among the rank and file of India: that is, among the victims of political and 'religious' leadership: the desire for a united India is becoming more and more insistent, and therefore the will to achieve a united India will arise. At this moment of India's agony the word *harmony* is on many lips—a word that will be responded to in ever widening circles as men and women—and even leaders—realize how utterly primitive, crude and unscientific are the disharmonious tendencies that come between Indian and Indian, tendencies that lead to the destruction of all that life holds dear in their common homeland.

As I write (March 29th) communal rioting has again broken out in Calcutta—8 killed and 86 injured. Curfew is imposed... I pick up "Lajwanti" and turn her pages...

Therein, Shanti sings:

"Come,

fill my Cup with Coffee, *good coffee*

its milk, Hindu;

its water, Muslim;

its colour British—

its sweetness: the sweetness of

Communal Harmony."

"SHANTI" SPEAKS

I. Passage to India

Passage to India !
For purpose vast, man's long probation filled,
Thou rondure of the world at last accomplished.

O vast Rondure, swimming in space, . . .
Now first, it seems, my thoughts begin to span
thee.

Year, at whose wide-flung door I sing !
Year of the purpose accomplished !
Year of the marriage of continents, climates and
oceans !
(No mere doge of Venice now wedding the
Adriatic,)
I see, O Year, in you the vast terraqueous globe
given and giving all.
Europe to Asia, Africa joined, and they to the
New World.
The lands, geographies, dancing before you, hold-
ing a festival garland,
As brides and bridegrooms—hand in hand.

Passage to more than India !
Passage to you, your shores, ye aged fierce
enigmas !
Passage to you, ye strangling problems !
You—strewed with the wrecks, that, living never
reached you.

Walt Whitman.

Time was—and not so long ago—when our
only short-cut between what is known and the

East and the West, was the Suez Canal. Walt Whitman—off the map, as it were, in America—reading accounts of the ceremonial opening of the Canal, on November 17th, 1869, was moved to make one of his greatest poems—*Passage to India*, — from which the foregoing is a selection.

To Whitman, the Suez Canal was more than passage to the land that was India, it was passage to “primal thought . . . to realms of budding bibles” It was the voyage of man’s mind, returning “to reason’s early paradise”—

“Back, back to wisdom’s birth,
to innocent intuitions.”

To Whitman it was also passage to the world—the One World of which, in his day, he never tired of singing, of which in our own day, scientists never tire of speaking and to which modern science is helping us rapidly to move.

What would Whitman have had to say and sing about the shortening of the Suez short-cut, by air? Speed, in itself, would not have counted for him so much as the fact that passage to India had been widened and the distant brought so near as to annihilate space.

Whitman sings for the New Age, of which he was a precursor—a prophet.

II. "My Utopia"—*A Scientist Speaks**

That a scientist is even asked to speak on Utopia, an imaginary island depicted by Sir Thomas More as enjoying a perfect social, legal and political system, speaks volumes for science, against the background of this distracted world. The true scientist, who is as much a visionary as a scientist should accept the invitation not as a challenge but as a triumph of the cause he stands for. The contribution which science has made—and will continue to make—towards the abolition of poverty and disease and to ensure a fuller and a richer life has been the most potent cause of its growing recognition. The realization of these results in contrast with the mess which is created in the world by diplomats and fanatical religious leaders, is helping to establish science in its true position. Even the havoc caused by the applications of science during this war will not be able to shake science from its exalted position.

The thinking world realizes that the message of science is not contained in the atomic bomb or the extermination inflicted by its application as a political weapon. The real message is contained in the silent desire of the scientist to see that atomic energy, in fact any energy, be

* Shanti Swarup Bhatnagar—A Radio Talk, given from New Delhi, A. I. R. Broadcasting Station. 17 October, 1945.

harnessed for the good of mankind. By annihilating space and time and by overcoming other natural obstacles that divide peoples and countries and by steadfast devotion to truth, science has done much to bring the idea of One World into actuality. It is for science now to shake off its philosophical detachment and assume its rightful position in shaping the destiny of man.

An ideally perfect island, isolated from the rest of the wicked world, is an impossibility. Perfection in only one part of the world connotes an imperfect world. The concept of One World is the scientist's Utopia and he should work with steadfastness to translate this dream into a reality. Let it be clearly understood, and there is no room for scepticism in this, that the Utopia of the scientist, ultimately, will materialize. *

Narrow Patriotism and the Atomic Bomb

There is, however, one thing against which the scientist will have to guard himself and that is; narrow patriotism. The atomic bomb and its great possibilities have already started controversies which if indulged in unscientifically will sow the seed of another war that might very well mean the end of civilization. Already some top-rank scientists have proclaimed to the world that the atomic bomb cannot remain a secret for long. Most scientists who have specialized in nuclear physics and chemistry understand the mechanism underlying the production of atomic power. There may be gaps here and there but these can be filled easily by any intelligent research worker in any part of the world. The

unfathoming of such mysteries is indeed the privilege of science but the task must not be vitiated by a militant mentality. Science may dominate Nature but it must not overwhelm Man. The aim of science is definitely to harness atomic energy for useful ends and if it is to remain a closed secret of Britain and the U.S.A., it is obvious that its applications for useful purposes will either be prevented or remain very limited in scope. A recent statement that the U.S.A., Canada and England will have the monopoly of atomic power and that the U.S.A. is not prepared to share the scientific knowledge regarding the atomic bomb with the rest of the world, is indicative of how statesmen and politicians, even in advanced countries, can hamper science in solving international problems. It is obvious that this secretiveness will have two definite effects. Firstly, in the present setting of power politics, it will lead Russia and other groups within its orbit to concentrate on research in this subject. Very soon the Soviet will be able to discover the secrets now being concealed from them, with perhaps a few more things not known at present even to the Americans and the British. Secondly, it will lead the U.S.A., and Britain to make frantic efforts to improve upon their present technique, and being victims of a common fear lest one should be outpaced by the other, both groups will concentrate upon discovering and utilizing this energy for destructive ends. American and British scientists have a clear duty before them of lodging an emphatic protest against this unscientific attitude of their

governments; otherwise science will cancel all that it has created for the good of mankind. On no account should decent scientific men agree to a procedure of abject secrecy in a matter which has such tremendous potentialities as atomic energy.

Atomic Energy and International Control.

We have unbounded faith in the courage of scientists, their honesty of purpose and the destiny of science. If scientists were ever forced to submit to secrecy in such vital research, a Galilio would arise from among them to smash political interference in matters of intellectual freedom. It would not be surprising if the problem evoked an upheaval of an unprecedented character in the usually peaceful precincts of learned societies and universities. The knowledge that among the people of the earth only a chosen few would be enabled to probe the secrets of atomic energy would result in mankind living in a state of continual alarm. It would lead to endless wars and a race for armaments of a magnitude unknown in human history. Indeed, one cannot think of a more effective way of destroying the high hopes raised by the 'Frisco Conference' of winning a lasting peace. Neither Art nor Science could ever flourish in conditions of life dominated by the primitive instinct of self-preservation. On the other hand, if the intelligent people of the world were consulted on the future control of atomic energy, they would undoubtedly vote against the exclusive control of this power by any one nation. They

would prefer an international control by people who have distinguished themselves by their stand in favour of peace and justice in the world. There is no doubt that international control would prevent the misuse of atomic power.

Political Versus Economic Internationalism

Failure does not baffle a scientist, it only creates in him the urge for a better planned and a more co-ordinated attack on the problem. The League of Nations, which was created after the last war with a view to banish war and to establish the politicians Utopia on earth, failed because it was essentially an Anglo-French-American solution which allowed the cancer of colonial imperialism to remain intact. The League failed because it did not conceive the idea of One World and because it attempted to solve the world's problems from the political standpoint. Scientists of the world have not lost hope and they passionately desire another lead from responsible men of the world in which the approach will not be made from the angle of political internationalism but from the point of view of economic and cultural internationalism in which not only the material resources of nations but their intellectual resources as well will form part of wealth, capable of international application on a planned basis. Economic internationalism cannot be conceived by any one nation alone or by a group of nations in isolation from the rest of the world. In fact, the fundamental principle which science and economics have arrived at is that no nation can reach its full

development or even maintain its prosperity alone. This emphasizes interdependance rather *than independence* as the aim of human endeavour. To a philosopher and a scientist, the fullest development of any nation means nothing less than a process of assimilation by that nation of all that is created by art, science and technology and which is capable of hastening progress in all spheres.

Science and Politics

In this Utopia of One World that the scientist visualizes, political controversies would not be examined from a racial or parochial standpoint, nor even on the basis of an emotional urge but from the point of view of sound sense—of how they affect the world as an organic whole in which individual countries would constitute so many integrated parts. Culture—instead of being Greek, Roman, Egyptian, Indian or British—would be just human culture. In the beginning it might be a hotch-potch of many diverse achievements, but like the American race which has shown a unique genius for racial and cultural synthesis, this One World would become a distinct entity.

Perhaps the most outstanding difference between the governments of the present world and those of this Utopia would be that the supreme government would not consist of, as at present in all governments, aggressive nationalists or apathetic isolationists, but of persons of wider culture, experience and outlook embracing the whole world as one family. Their intellectual

and moral make-up would be due to the essential training in basic science and the humanities, which would enable them to examine important issues dispassionately. It may be that the method of the ballot would be retained for placing persons in positions of trust and responsibility but, with the changed outlook, the test of elections would not be dominated by local or national issues *vis-a-vis* world considerations.

In this new civilization, which might well be looked upon as the Child of Applied Science, the scientist would have to shoulder responsibility for its stability and development. Those who control affairs of the world today have a training which but fits them to be diplomats and executives. Meanwhile, scientists and philosophers are considered lesser men if they take interest in statecraft or in the development of their country. It is obvious that if we are to pursue philosophy, poetry and science in this new civilization, not as mere pastimes but as nursing factors of mankind, then, the government of the new world must have a fair representation of these comparatively absent factors in the various governments of the present world.

Under the influence of science, the world would mobilize all its resources as one unit and with the set purpose of banishing poverty and raising the standard of living of the human race. When the object of the whole world becomes the advancement of the human race, national or party interests and clashes which breed hatred and war would cease and the desire for advancement of common welfare based on an apprecia-

tion of mutuality of interest would grow from more to more.

Science and Religion

In the One World of the future, the conflict between religion and science, that waged so vigorously in the last century, but that seems to have subsided in the present on terms of mutual toleration, will acquire a new significance. The trend of physics shows that these two divergent ideas are capable of being synthesized and it appears that in the Utopia of the scientist, Religion and Science will be brought into a fertile union in which the idea of Supreme Being (commonly called God) instead of being impoverished will be enriched. Idealism and Achievement—although two different words—may then acquire one meaning.

III Indian Science Congress, 1947.

In January, 1947, Science in India had flung wide her net and landed upon her shores "an exceedingly distinguished body of scientists from other lands." They came from Britain, America, France, Russia, Australia and China. "Never before have scientists from so many foreign countries met together on the soil of India... That there is a sphere in which a common ground exists is no small thing at the present day, and we may all be grateful to the scientists for affording us so inspiring an example of international concord and co-operation... Many of us believe that the future happiness of the world rests largely in the hands of the scientists and it is not their fault that others, at times, pervert to ignoble uses the gifts which science gives us."

Thus spoke the learned and wise Vice-Chancellor of the University of Delhi, Chairman of the Reception Committee, who, in his brief address, was able to enumerate but a few names of the eminent men from foreign lands among their visitors. Among these few, chief among them was the leader of the British group of scientists, "who bore an immortal name." Also, he named the Astronomer Royal from England. Others there were, but to their great disappointment, not one "who is renowned

world over as the Father of modern physics." His name was spoken. Special greeting was given to one who "notwithstanding the 86 years which he bears so lightly, has shown the adventurous spirit of youth in travelling by air to India and who unites with his distinction in science no less in the field of humanities...It is with a heart full of thankfulness on behalf of this university—and of all universities in India—that I welcome the Indian Science Congress and its guests."

The President of the Congress, for the best part of an hour spoke spontaneously, the vast audience keyed to the highest pitch of attention and warmly responsive.

He had not accepted the honour of presiding because he was associated with the government. "I would not like to encourage any tendency among scientists to honour authority too much. (laughter)...I do represent, however, in a small measure something of the new India that you see rising about us... What is really big about India is that the whole people are on the move. When a whole people suddenly discovers this power of movement, they go astray here and there. The main thing is, the vitality they possess and even if they err and go astray, they will come back on the right path because they are vital and are in movement. I am certain that India has a tremendous future, so that I ask you to consider the picture of India in the broader aspect and not to confine your attention to our immediate troubles. There is trouble enough in every country in the world today. That is inevitable in this mighty period of transition. What is far

more important is how we are going to develop. The special task of the scientist is to lead, to develop and to co-ordinate... Our task in India is threefold—to make the country free so that the energy of the people may be released. Secondly, to provide full opportunity for development and thirdly to make co-ordinated plans... I believe that all problems, both world problems and national, should have a scientific approach (cheers). That is, that this approach should be imbued with the spirit of science and proceed by the scientific method. That method is co-ordinated planning. Governments are normally very slow but speaking for my colleagues and particularly for myself, we will do everything in our power to encourage scientific research in India... We want to co-operate with scientists from abroad in every way to advance the cause of peace in the world and the progress of humanity. While giving this undertaking and pledge I want to make it perfectly clear that we will not co-operate in the ways of war." This declaration was greeted with thunderous applause. The President admonished scientists not to allow themselves to be exploited for war. "Nearly two years ago," he continued, "a bomb burst on Hiroshima....."

At this utterance, the screens of canvas that enclosed the vast assembly vanished. India vanished. *Anno Domini* vanished... and Hiroshima appeared.

It was no longer January the third, 1947 A.D. but January the third Annum Secundum... the Atomic Age.

“ I speak, I—Hiroshima :
 final sacrifice on
 the furnace of
Power :
 first offering on
 the altar of
Peace.

I have risen—risen from the grave.

I have risen—
Power is dead.”

Atomic Musings

"The dropping of the bomb on Hiroshima has changed the world."

(Unidentified)
7 August, 1945.

"Discovery of how to confine and release atomic energy harnesses the basic power of the universe—the force from which the sun draws its power."

—*President Truman.*
7 August, 1945.

"That which is found concentrated in the Atom bomb is the energy that keeps the stars radiating."

—*An Oxford University Physicist.*
7 August, 1945.

"I do not hold a thanksgiving in St. Albans because I cannot honestly give thanks to God for an event brought about by the wrong use of force, by an act of wholesale, indiscriminate massacre, which is different in kind from all acts of open warfare hitherto, however brutal and hideous."

—*C. C. Thicknesse.*
Dean of St. Alban's Abbey,
8 August, 1945.

"Nations need a creative atomic policy... The world's Magna Carta framed at Dumbarton Oaks and San Francisco is fundamentally out of date already."

/

is wanted is a wholly new kind of vital agency for the creative policy."

—*J. L. Garvin.*

8 August, 1945.

"The atomic bomb makes necessary a revolution in the government of mankind. All past talk about every nation insisting upon its sovereignty or its right of ultimate individual decision in issues of peace and war is out of date.

The ultimate justification of the decision to use the atomic bomb against Japan will depend on its service in showing to humanity the danger to which all are exposed if war is allowed to recur. That decision has brought the world to the necessity of abolishing war."

—*Sir William Beveridge.*

14 August, 1945.

"War will cease when statesmen are intelligent enough to realize what the man in the street has known for a long time that it is a wicked game and a fool's game. The atomic bomb brings this moment nearer, not because it adds to the wickedness of war, for nothing could do that, but because it makes plain even to sub-human intelligence the folly of it."

—*A. A. Milne.*

14 August, 1945.

"British scientists are adamant that atomic energy, which is peculiarly the fruit of the genius of Lord Rutherford and other British men of science, shall be used for the benefit of mankind as a whole and that neither this nation, nor any other, shall prevent its full and complete development by using it as power politics."

—*Prof. M. S. L. Oliphant,*

October, 1945.

"The thinking world realizes etc. . . .

(As from next page). . . .

. . . by the primitive instinct of self-preservation."

—S. S. Bhatnagar,

October, 1945.

"Only scientists can now effectively place under restraint the destructive forces of the atom which the manufacture of the atom bomb by British, United States and Canadian scientists has brought to light."

—*Editorial, Civil and Military Gazette, Lahore.*

6 November, 1945.

"What the United States, Russia, Britain, France, China and all the United Nations have to accomplish is not to attempt to bury the secret of the atom bomb, which refuses to be buried, but to prevent the manufacture of the atom bomb by any country in the world. . . . If other countries were to follow the course Russia apparently proposes to follow, namely, to explore ways and means of mobilizing atomic energy in the service of mankind, it would leave no time to scientists to undertake the manufacture of atom bombs."

—*The Same.*

8 November, 1945.

"Logic leads straight to the ultimate conclusion that the only way in which the atom bomb can be abolished is by abolishing the sovereign State and by creating a world State, so powerful that no lesser unit can pursue any secret policy." —

—"Economist"

November, 1945.

"Our eyes should be fixed upon the United Nations to judge their policy, as to whether they can create a world organization capable, masterful enough, un-

enough, to hold in check the evolution of scientific discovery and make it the servant of man and not his destroyer."

—*Ernest Beven.*

7 November, 1945.

" Failure does not baffle a scientist, it only creates in him the urge for a better planned and a more co-ordinated attack on the problem. The League of Nations, which was created with a view to banish war and to establish the politicians heaven upon earth, failed because it did not conceive the idea of One World and because it attempted to solve the world's problems from the political standpoint. Scientists of the world have not lost hope and they passionately desire another lead from responsible men of the world in which the approach will not be made from the angle of political internationalism but from the point of view of economic and cultural internationalism in which not only the material resources of nations but their intellectual resources as well will form part of wealth, capable of international application on a planned basis.

In the One World that the scientist visualizes, political controversies would not be examined from a racial or parochial standpoint. Culture—instead of being Greek, Roman, Egyptian, Indian or British—would be just human culture.

The outstanding difference between the Governments of the present world and those of the cultural future would be that the Supreme Government would not consist of, as at present in all governments, aggressive nationalists or apathetic isolationists, but of persons of wider culture, experience and outlook embracing the whole world as one family. . . . In this new civilization, the scientist would have to shoulder responsibility for its stability and development. Those who control the affairs of the world to-day have a training which but fits them to be diplomats and executives. Meanwhile scientists and philosophers are considered lesser men if they take

interest in statecraft or in the development of their country. It is obvious that if we are to pursue philosophy, poetry and science in this new civilization, not as mere pastimes but as nursing factors of mankind, then, the Government of the new world must have a fair representation of these comparatively absent factors in the various Governments of the present world.

—*S. S. Bhatnagar.*

October, 1945.

"I hold that the United Nations Organization must be something more than an agreement between Governments. It must be an expression of the will of the common people in every country. . . .

In facing world problems it is a mistake to think constantly of war and prevention of war. We have to think rather of the best means of building up peace. . . .

Our civilization can only survive by acceptance and practice in international relations and in our national life of the Christian principle that we are All Members of One Another."

—*Clement Atlee.*

November, 1945.

"The world must cease to be an armed camp. . . . In this atomic age our common interests in creating peace far out-weigh any possible conflict in interests that might divide us. At this first session of the General Assembly we must seek with all our hearts and all our minds to find means of reconciling our views and our interests for the common good of all humanity. . . . Peace and Reconciliation require unilateral action. Peace and Reconciliation require common action."

—*James R. Roosevelt.*

January, 1946.

"Quit India and Quit the world is the command of the Time Spirit to Power—echoed over and over again by the Wise of the Earth.

UNESCO is endeavouring to replace Power by Culture, for on no other basis can the world find peace—or, at the very least, absence of war. Peace will come later, when humanity has realized what are true values through cultural administration under a One World Federal Government."

—N. M. H. Richards.

21 April, 1947.

Food for Thought

Whether the Tree of Knowledge has at last borne the fruit of which mankind was warned long ago by a voice which said. "In the day thou eatest thereof thou shalt surely die."

Whether the use of atomic energy in peace for endowing mankind with unlimited wealth and leisure would destroy mankind no less effectively than its use for bombing in war, and whether the moral destruction of the race is preferable to the physical, and less to be feared.

Whether an age, civilization, culture or policy which conceives the Public Good in terms of wealth, leisure and creature comforts, with security from want and fear, and takes it for granted that the Universe will complacently lend its basic energy for the achievement for such a Good, is heading for the bottomless pit.

Whether the age long martyrdom of Man, now threatened with appalling intensification, is primarily due to his age-long neglect of the counsel of Socrates, who went about Athens imploring the young men to despise material riches and concentrate on getting good souls. . . ."

—L. P. Jacks.

October, 1945.

"The thinking world realizes that the message of science is not contained in the atomic bomb or the extermination inflicted by its application as a political weapon. The real message is contained in the silent desire of the scientist that atomic energy, in fact any energy, be harnessed for the good of mankind. . . .

The unfathoming of atomic mysteries is the privilege of science but the task must not be vitiated by a militarist mentality. Science may dominate Nature but it must not overwhelm Man. A recent statement that the U.S.A. is not prepared to share the scientific knowledge regarding the atomic bomb with the rest of the world, is indicative of how statesmen and politicians, even in advanced countries, can hamper science in solving international problems. Scientists have a clear duty before them of lodging an emphatic protest against this unscientific attitude. On no account should they agree to a procedure of abject secrecy in a matter which has such tremendous potentialities as atomic energy.

We have unbounded faith in the courage of scientists, their honesty of purpose and the destiny of science. If scientists were ever forced to submit to secrecy in such vital research, a Galilee would arise from among them to smash political interference in matters of intellectual freedom. It would not be surprising if the problem evoked an upheaval of an unprecedented character in the usually peaceful precincts of learned societies and universities. The knowledge that among the people of the earth only a chosen few would be able to probe the secrets of atomic energy would result in mankind living in a state of continual alarm. It would lead to endless wars and a race for armaments of a magnitude unknown in human history. Neither Art nor Science could ever flourish in conditions of life dominated by the primitive instinct of self-preservation.

—S. S. Bhatnagar.

October, 1945.

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